

# Carbon Programming

Classic

Carbon

Cocoa

Java







# Carbon Programming

K.J. Bricknell

**SAMS**

201 West 103rd Street, Indianapolis, Indiana, 46290



# Carbon Programming

## Copyright © 2002 by Sams Publishing

All rights reserved. No part of this book shall be reproduced, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without written permission from the publisher. No patent liability is assumed with respect to the use of the information contained herein. Although every precaution has been taken in the preparation of this book, the publisher and author assume no responsibility for errors or omissions. Nor is any liability assumed for damages resulting from the use of the information contained herein.

International Standard Book Number: 0-672-32267-6

Library of Congress Catalog Card Number: 2001095005

Printed in the United States of America

First Printing: November 2001

04 03 02 01                      4 3 2 1

## Trademarks

All terms mentioned in this book that are known to be trademarks or service marks have been appropriately capitalized. Sams Publishing cannot attest to the accuracy of this information. Use of a term in this book should not be regarded as affecting the validity of any trademark or service mark.

## Warning and Disclaimer

Every effort has been made to make this book as complete and as accurate as possible, but no warranty or fitness is implied. The information provided is on an "as is" basis. The author and the publisher shall have neither liability nor responsibility to any person or entity with respect to any loss or damages arising from the information contained in this book.

### EXECUTIVE EDITOR

*Jeff Schultz*

### ACQUISITIONS EDITOR

*Loretta Yates*

### DEVELOPMENT EDITOR

*Damon Jordan*

### MANAGING EDITOR

*Charlotte Clapp*

### INDEXER

*Ron Strauss*

### TECHNICAL EDITOR

*Russell Schelby*

### TEAM COORDINATOR

*Amy Patton*

### INTERIOR DESIGNER

*Gary Adair*

### COVER DESIGNER

*Bill Thomas*

### PAGE LAYOUT

*Mark Walchle*



# Contents at a Glance

1	Introduction	<b>xxxi</b>
1	System Software, PowerPC Run-Time Environment, Managing Memory, and Resources	<b>1</b>
2	The Classic Event Manager—Low-Level and Operating System Events	<b>41</b>
3	Menus	<b>79</b>
4	Introduction to Windows	<b>155</b>
5	Carbon and Universal Procedure Pointers	<b>211</b>
6	The Appearance Manager	<b>219</b>
7	Introduction to Controls	<b>247</b>
8	Dialogs and Alerts	<b>339</b>
9	The Finder and the Application	<b>427</b>
10	Apple Events	<b>455</b>
11	QuickDraw Preliminaries	<b>495</b>
12	Drawing with QuickDraw	<b>531</b>
13	Offscreen Graphics Worlds, Pictures, Cursors, and Icons	<b>601</b>
14	More on Controls	<b>661</b>
15	Carbon Printing	<b>795</b>
16	More on Windows	<b>847</b>
17	The Carbon Event Manager	<b>891</b>
18	Files And Navigation Services	<b>947</b>
19	More on Resources and Core Foundation Preferences	<b>1049</b>
20	Carbon Scrap	<b>1093</b>
21	Text, Textedit, Dates, Times, and Numbers	<b>1133</b>
22	Lists and Custom List Definition Functions	<b>1237</b>
23	Drag and Drop	<b>1307</b>
24	Basic Sound and Speech	<b>1367</b>
25	Miscellany	<b>1397</b>
26	More on Text—Multilingual Text Engine	<b>1441</b>
	Index	<b>1513</b>



# Contents

<b>1</b>	<b>System Software, PowerPC Run-Time Environment, Managing Memory, and Resources</b>	<b>1</b>
	System Software .....	2
	PowerPC Run-Time Environment .....	4
	Fragments .....	4
	Organization of Memory .....	5
	Managing Memory—Mac OS 8/9 .....	6
	Inside the Application Heap—Nonrelocatable and Relocatable Memory Blocks .....	6
	Heap Fragmentation, Compaction, and Purging .....	8
	Master Pointer Tag Byte—HGetState and HSetState .....	13
	Memory Leaks .....	14
	Memory Manager Errors .....	15
	Managing Memory—Mac OS X Considerations .....	15
	Preamble—Memory in Mac OS X .....	15
	Memory Management Considerations .....	15
	Resources .....	16
	About Files—The Data Fork and the Resource Fork .....	16
	Resources and the Application .....	17
	Resource Types and Resource IDs .....	18
	Creating a Resource .....	19
	Template Resources and Definition Resources .....	21
	Resources in Action .....	22
	Resource Manager Errors .....	25
	Main Memory Manager Data Types and Functions .....	26
	Data Types .....	26
	Function .....	26
	Main Resource Manager Constants, Data Types, and Functions .....	27
	Constants .....	27
	Data Types .....	27
	Functions .....	27
	Demonstration Program SysMemRes Listing .....	28
	Demonstration Program SysMemRes Comments .....	31
<b>2</b>	<b>The Classic Event Manager—Low-Level and Operating System Events</b>	<b>41</b>
	The Two Event Managers .....	42
	Overview of the Classic Event Model .....	42
	The Main Event Loop .....	42
	Categories of Events .....	43

Processes and Events .....	44
Low-Level and Operating System Events, System Software, and Applications .....	44
Priority of Events .....	45
Obtaining Information About Events .....	46
The Event Structure .....	46
The WaitNextEvent Function .....	50
Flushing the Operating System Event Queue .....	52
Handling Events .....	52
Handling Mouse Events .....	52
Handling Keyboard Events .....	55
Handling Update Events .....	57
Handling Activate Events .....	58
Handling Null Events .....	59
Handling Suspend and Resume Events .....	59
Handling Mouse-Moved Events .....	60
Handling Events in Alerts and Dialogs .....	61
Modal and Movable Modal Alerts .....	61
Modal and Movable Modal Dialogs .....	61
Modeless Dialogs .....	61
The 'SIZE' Resource .....	62
Resource ID .....	62
Creating a 'SIZE' Resource in CodeWarrior .....	62
Main Event Manager Constants, Data Types and Functions .....	65
Constants .....	65
Data Types .....	66
Functions .....	67
Demonstration Program LowEvents Listing .....	67
Demonstration Program LowEvents Comments .....	72

### 3 Menus 79

Introduction—Types of Menus .....	80
Pull-Down Menus .....	80
Menu Definition Functions and Menu Bar Definition Functions .....	80
Standard Menu and Menu Bar Definition Functions .....	80
The Menu Bar and Menus .....	81
Menus .....	81
Menu Items .....	82
Groups of Menu Items .....	82
Keyboard Equivalents for Menu Commands .....	83
The Mac OS 8/9 Apple Menu and Mac OS X Application Menu .....	84

The File Menu .....	85
The Edit Menu .....	85
The Mac OS 8/9 System-Managed Menus .....	86
Mac OS Help Menus .....	87
Font Menus .....	87
Hierarchical Menus .....	88
Pop-Up Menus .....	88
Menu Objects, Menu IDs and Item Numbers, Command IDs, and Menu Lists .....	89
The Menu Object .....	89
Menu IDs and Item Numbers .....	91
Command IDs .....	91
The Menu List .....	91
Creating Your Application's Menus .....	91
'MBAR', 'MENU', and 'xmnu' Resources .....	91
Creating 'MBAR', 'MENU', and 'xmnu' Resources Using Resorcerer .....	100
Creating the Menu Bar and Pull-Down Menus .....	104
Creating a Hierarchical Menu .....	104
Adding Menus to the Menu List .....	105
Providing Help Balloons (Mac OS 8/9) .....	105
'hmmu' Resources .....	105
Changing Menu Item Appearance .....	108
Enabling and Disabling Menu Items .....	108
Other Appearance Changes .....	108
Adding Items to a Menu .....	109
Adding Items Other Than the Names of Resources .....	109
Adding Items Comprising Resource Names to a Menu .....	112
Associating Data With Menu Items .....	112
Handling Menu Choices .....	112
Determining the Menu ID and Menu Item—MenuSelect and MenuEvent .....	112
Unhighlighting the Menu Title .....	113
Adjusting Menus .....	113
Handling Mac OS 8/9 Apple Menu Choices .....	114
Handling Mac OS X Application Menu Choices .....	115
Handling a Size Menu .....	115
Hiding and Showing the Menu Bar .....	116
Accessing Menus From Alerts and Dialogs .....	116
Main Menu Manager Constants, Data Types, and Functions .....	116
Constants .....	116
Data Types .....	117
Functions .....	117



Demonstration Program Menus1 Listing .....	120
Demonstration Program Menus1 Comments .....	131
Demonstration Program Menus2 Listing .....	136
Demonstration Program Menus2 Comments .....	149
<b>4 Introduction to Windows 155</b>	
Scope of This Chapter .....	156
Window Basics .....	156
Windows, Documents, the Window Manager	
and Graphics Ports .....	156
Standard Window Elements .....	156
Active and Inactive Windows .....	157
Window Layering .....	158
Types of Windows .....	158
Document Types .....	159
Dialog and Alert Types .....	160
Floating Window Types .....	161
Window Definition IDs .....	162
Window Type Usage .....	164
Window Regions .....	164
The Desktop (Gray) Region .....	167
Controls and Control Lists .....	167
The Window List .....	168
The Graphics Port and the Window Object .....	168
The Graphics Port .....	168
The Window Object .....	169
Events in Windows .....	171
Creating Your Application's Windows .....	171
'WIND' Resources .....	171
Creating a 'WIND' Resource Using Resorcerer .....	174
Creating the Window from the 'WIND' Resource .....	174
Positioning a New Document Window on the Desktop .....	175
Positioning a Saved Document Window on the Desktop .....	175
Drawing a Window's Contents .....	176
Managing Multiple Windows and Associated Data .....	176
Handling Events .....	177
Handling Mouse Events .....	177
Handling Keyboard Events .....	177
Handling Update Events .....	177
Handling Activate Events .....	180
Manipulating Windows .....	180
Dragging a Window .....	180
Zooming a Window .....	181

Resizing a Window .....	182
Closing a Window .....	183
Hiding and Showing a Window .....	184
Providing Help Balloons (Mac OS 8/9) .....	184
Help Balloons—'hrct' and 'hwin' Resources .....	184
Creating 'hrct' and 'hwin' Resources Using Resorcerer .....	184
Main Window Manager Constants, Data Types, and Functions .....	187
Constants .....	187
Data Types .....	188
Functions .....	188
Demonstration Program Windows1 Listing .....	190
Demonstration Program Windows1 Comments .....	202
<b>5 Carbon and Universal Procedure Pointers 211</b>	
Introduction .....	212
The 68LC040 Emulator and the Mixed Mode Manager .....	213
The Emulator .....	213
The Mixed Mode Manager .....	213
Mode Switches .....	213
Intervention in Mode Switching .....	214
Disposing of Routine Descriptors .....	215
Functions Requiring Routine Descriptors .....	216
Universal Procedure Pointers and Carbon .....	216
Creation/Disposal Functions Relevant to Demonstration Programs .....	217
<b>6 The Appearance Manager 219</b>	
History .....	220
Themes—New Definition .....	221
Theme-Compliance .....	221
The Appearance Manager .....	222
New Definition Functions—Mac OS 8/9 .....	222
Colors, Patterns, and Appearance Primitives .....	223
Appearance Manager Text .....	227
Saving and Setting the Graphics Port Drawing State .....	228
Cursor Setting .....	228
Getting Menu Bar Height .....	228
Appearance Manager Apple Events .....	228
Main Constants, Data Types, and Functions .....	229
Constants .....	229
Data Types .....	230
Functions .....	230
Demonstration Program Appearance Listing .....	231
Demonstration Program Appearance Comments .....	242

**7 Introduction to Controls 247**

Introduction .....	248
Standard Controls .....	248
Available Standard Controls .....	248
Controls Addressed in This Chapter .....	254
The Control Definition Function .....	255
The Basic Controls, Primary Group Boxes (Text Title Variant), and User Panes .....	256
Push Buttons .....	256
Checkboxes .....	257
Radio Buttons .....	257
Scroll Bars .....	258
Pop-Up Menu Buttons .....	259
Primary Group Boxes (Text Title Variant) .....	260
User Panes .....	260
Activating, Deactivating, Hiding, Showing, Enabling, and Disabling Controls .....	260
Activating and Deactivating Controls .....	260
Hiding and Showing Controls .....	261
Enabling and Disabling Controls .....	262
Visual Feedback from the Basic Controls .....	262
Embedding Controls .....	263
The Root Control .....	263
Other Embedders .....	263
Other Advantages of Embedding .....	264
Latency .....	265
Getting and Setting Control Data .....	265
The Control Object .....	266
Accessor Functions .....	266
Creating Controls .....	268
Creating Controls From 'CNTL' Resources .....	268
Creating Controls Programmatically .....	271
Additional Considerations—Scroll Bars .....	272
Additional Considerations—Pop-up Menu Buttons .....	274
Setting the Font of a Control's Title .....	275
Setting and Getting Control IDs .....	278
Updating, Moving, and Removing Controls .....	279
Updating Controls .....	279
Moving Controls .....	279
Removing Controls .....	279
Handling Mouse Events in Controls .....	279
Overview .....	279
Determining a Mouse-Down Event in a Control .....	280
Tracking the Cursor in a Control .....	281

Determining and Changing Control Settings, and Getting a	
Control's Kind .....	282
Determining and Changing Control Settings .....	282
Getting a Control's Kind .....	282
Moving and Resizing Scroll Bars .....	283
Scrolling Operations With Scroll Bars .....	283
Scrolling Basics .....	283
Scrolling Example .....	285
Scrolling a TextEdit Document and Scrolling Using the	
List Manager .....	287
Small Versions of Controls .....	287
Main Control Manager Constants, Data Types and Functions	
Relevant to the Basic Controls, Primary Group Box	
and User Panes .....	288
Constants .....	288
Data Types .....	291
Functions .....	292
Demonstration Program Controls1 Listing .....	294
Demonstration Program Controls1 Comments .....	314
Demonstration Program Controls2 Listing .....	323
Demonstration Program Controls2 Comments .....	334
<b>8 Dialogs and Alerts 339</b>	
Introduction .....	340
Alert Types, Modalities, and Levels .....	340
Alert Types and Modalities .....	340
Levels of Alert .....	340
Dialog Types and Modalities .....	342
Modal Dialog .....	342
Movable Modal Dialog .....	343
Modeless Dialog .....	343
Window-Modal (Sheet) Dialog—Mac OS X .....	343
Window Types for Alerts and Dialogs .....	343
Content of Alerts and Dialogs .....	345
Default Push Buttons .....	345
Removing Dialogs .....	345
Creating and Removing Alerts .....	345
The StandardAlert Function .....	346
The CreateStandardAlert Function .....	349
Removal of Alerts .....	349
Creating Dialogs .....	350
The Dialog Object .....	350
'DLOG' and 'dlgX' Resources .....	351
The NewFeaturesDialog Function .....	354

Items in Dialogs .....	355
Preamble—Dialog Manager Primitives .....	355
The ‘DITL’ Resource .....	356
Layout Guidelines for Dialogs .....	358
Default Push Buttons .....	358
Enabling and Disabling Items .....	360
Keyboard Focus .....	360
Manipulating Items .....	360
Setting the Font for Controls in a Dialog—‘dftb’ Resources .....	363
Displaying Alerts and Dialogs .....	367
Window Deactivation and Menu Adjustment .....	367
Displaying Multiple Alerts and Dialogs .....	369
Resizing a Dialog .....	369
Handling Events in Alerts and Dialogs .....	370
Overview .....	370
Responding to Events in Controls .....	370
Responding to Events in Modal and Movable Modal Alerts .....	371
Responding to Events in Modal and Movable Modal Dialogs .....	372
Event Filter (Callback) Functions for Modal and Movable Modal Alerts and Dialogs .....	374
Responding to Events in Modeless Dialogs .....	377
Closing and Disposing of Dialogs .....	377
Creating Displaying and Handling Window-Modal (Sheet) Alerts and Dialogs .....	378
Window-Modal (Sheet) Alerts .....	378
Window-Modal (Sheet) Dialogs .....	379
Balloon Help for Dialogs—Mac OS 8/9 .....	379
Help Tags for Dialogs—Mac OS X .....	382
Main Dialog Manager Constants, Data Types and Functions .....	382
Constants .....	382
Data Types .....	383
Functions .....	384
Relevant Window Manager Functions (Mac OS X Only) .....	386
Demonstration Program DialogAndAlerts Listing .....	386
Demonstration Program DialogsAndAlerts Comments .....	413
DialogsAndAlerts.h .....	415
DialogsAndAlerts.c .....	416
Sheets.c .....	426
<b>9 The Finder and the Application 427</b>	
Introduction .....	428
The Finder .....	428
Relevant Databases .....	428



An Application's Required Resources .....	429
Application Signature, File Creator, and File Types .....	430
Application Signature .....	430
File Creator and File Type .....	431
Icons for the Finder .....	432
The Icon Family .....	433
Huge Icons, 32-Bit Icons, and Deep Masks .....	434
Thumbnail Icons, the 'icns' Resource, and Mac OS X .....	434
Creating Icon Resources .....	434
File Reference ('FREF') Resources .....	436
Structure of the 'FREF' Resource and Creating a 'FREF'	
Resource Using Resorcerer .....	436
Use of 'FREF' Resources by the Finder .....	437
The Bundle ('BNDL') Resource .....	437
Structure of the 'BNDL' Resource and Creating a 'BNDL'	
Resource Using Resorcerer .....	438
Resource IDs, Local Ids, and the Desktop Database .....	439
Informing the Finder that Your Application has a 'BNDL'	
Resource .....	440
The Version ('vers') Resource .....	440
Structure of the 'vers' Resource and Creating a 'vers'	
Resource Using Resorcerer .....	441
Finder Icon Help ('hldr') Resource—Mac OS 8/9 .....	442
Missing Application and Application-Missing Resources—	
Mac OS 8/9 .....	442
Missing Application and Application Missing .....	443
The 'plst' Resource and Information Property Lists .....	445
Example Information Property List .....	445
Creating the 'plst' Resource .....	447
Application Launching by the Finder .....	448
The Finder and the Catalog File .....	448
Finder Flags .....	449
Preferences, Temporary Items, and Trash Folders—	
Using FindFolder .....	450
Stationery Pads .....	450
Stationery Pads and the Finder .....	450
Stationery Pads and Navigation Services .....	450
Using Aliases .....	451
Mac OS 9 Packages and Mac OS X Bundles .....	451
Mac OS 9 Packages .....	451
Mac OS X Bundles .....	453

Relevant Constants, Data Types, and Functions .....	453
Constants .....	453
Data Types .....	453
Functions .....	454
Demonstration Programs .....	454
Missing Application Name String and Application-	
Missing String ('STR ') Resources .....	454
Preferences, Temporary Items, and Trash Folders .....	454
<b>10 Apple Events 455</b>	
Introduction .....	456
Apple Event Attributes and Parameters .....	457
Apple Event Attributes .....	457
Apple Event Parameters .....	459
Attributes and Parameters in an Open Documents	
Apple Event .....	459
Data Structures Within Apple Events .....	460
Descriptor Structures .....	460
Keyword-Specified Descriptor Structures .....	461
Descriptor Lists, AE Structures, and AppleEvent Structures .....	462
Example Complete Apple Event .....	463
Handling Apple Events .....	465
Apple Event Handlers .....	465
Required Apple Events—Contents and Required Action .....	467
Main Apple Event Manager and Appearance Manager	
Constants, Data Types, and Functions Relevant to Required	
Apple Events and Appearance Manager Apple Events .....	470
Constants .....	470
Data Types .....	471
Functions .....	471
Demonstration Program AppleEvents .....	472
Demonstration Program AppleEvents Comments .....	487
<b>11 QuickDraw Preliminaries 495</b>	
QuickDraw and Imaging .....	496
RGB Colors and Pixels .....	496
Color and the Video Device .....	496
Indexed Color Devices .....	497
Direct Color Devices .....	497
Graphics Port .....	499
Pixel Maps .....	502
Pixel Patterns .....	505
Bit Patterns .....	505
Creating Graphics Ports .....	506

Translation of RGB Colors to Pixel Values .....	506
Derivation of Pixel Values on Indexed Devices .....	507
Derivation of Pixel Values on Direct Devices .....	507
Colors on Grayscale Screens .....	509
Graphics Devices and GDevice Structures .....	509
Types of Graphics Device .....	509
GDevice Structure .....	509
Setting a Device's Pixel Depth .....	511
Other Graphics Managers .....	511
Palette Manager .....	511
Color Picker Utilities .....	511
Coping with Multiple Monitors .....	512
Relevant QuickDraw Constants, Data Types, and Functions .....	512
Constants .....	512
Data Types .....	512
Functions .....	514
Demonstration Program PreQuickDraw Listing .....	516
Demonstration Program PreQuickDraw Comments .....	527
 <b>12 Drawing with QuickDraw 531</b>	
Introduction .....	532
The Coordinate Plane, Points, Rectangles, and Regions .....	532
The Coordinate Plane .....	532
Points .....	532
Rectangles .....	533
Regions .....	534
The Graphics Pen, Foreground and Background Colors, Pixel Patterns and Bit Patterns, and Transfer Modes .....	535
The Graphics Pen .....	535
Foreground and Background Color .....	536
Pixel Patterns and Bit Patterns .....	536
Transfer Modes .....	537
Drawing Lines and Framed Shapes .....	540
Functions for Drawing Lines .....	540
Functions for Drawing Framed Shapes .....	540
Drawing Painted and Filled Shapes .....	542
Functions for Painting and Filling Shapes .....	542
Erasing and Inverting Shapes .....	544
Functions for Erasing and Inverting Shapes .....	544
Drawing Pictures .....	545
Drawing Text .....	545
Setting the Font .....	545
Setting and Modifying the Text Style .....	546

Setting the Font Size .....	546
Changing the Width of Characters .....	546
Transfer Mode .....	546
Copying Pixel Images Between Graphics Ports .....	547
Using Masks .....	548
Transfer Modes .....	548
The Importance of Foreground and Background Color .....	548
Dithering .....	548
Copying from Offscreen Graphics Ports .....	548
Scrolling Pixels in the Port Rectangle .....	549
Manipulating Rectangles and Regions .....	549
Manipulating Rectangles .....	549
Manipulating Regions .....	550
Manipulating Polygons .....	550
Scaling Shapes and Regions Within the Same Graphics Port .....	550
Highlighting .....	551
Drawing Other Graphics Entities .....	551
Saving and Restoring the Graphics Port Drawing State .....	552
Main QuickDraw Constants, Data Types and Functions .....	553
Constants .....	553
Data Types .....	554
Functions .....	555
Relevant Appearance Manager Data Types and Functions .....	558
Data Types .....	558
Functions .....	558
Demonstration Program QuickDraw Listing .....	559
Demonstration Program QuickDraw Comments .....	589
<b>13 Offscreen Graphics Worlds, Pictures, Cursors, and Icons   601</b>	
Offscreen Graphics Worlds .....	602
Introduction .....	602
Creating an Offscreen Graphics World .....	602
Setting the Graphics Port .....	603
Preparing to Draw into an Offscreen Graphics World .....	603
Copying an Offscreen Image into a Window .....	604
Updating an Offscreen Graphics World .....	604
Disposing of an Offscreen Graphics World .....	604
Pictures .....	605
Introduction .....	605
The Picture Structure .....	605
Opcodes: Drawing Commands and Picture Comments .....	606
‘PICT’ Files, Resources, and Scrap Format .....	606
Creating Pictures .....	606

Opening and Drawing Pictures .....	607
Saving Pictures .....	607
Gathering Picture Information .....	608
Cursors .....	608
Introduction .....	608
Cursor Movement, Hot Spot, Visibility, and Shape .....	608
Non-Animated Cursors .....	609
Animated Cursors—Mac OS 8/9 .....	612
Icons .....	614
Icons and the Finder—Icon Families .....	614
Other Icons—Icons, Color Icons and Small Icons .....	614
Icons in Windows, Menus, and Alerts and Dialogs .....	615
Drawing and Manipulating Icons .....	616
Main Constants, Data Types and Functions—Offscreen	
Graphics Worlds .....	619
Constants .....	619
Data Types .....	619
Functions .....	619
Main Constants, Data Types and Functions—Pictures .....	620
Constants .....	620
Data Types .....	620
Functions .....	621
Main Constants, Data Types and Functions—Cursors .....	622
Constants .....	622
Data Types .....	622
Functions .....	623
Appearance Manager Constants, Data Types and	
Functions—Cursors .....	624
Constants .....	624
Data Types .....	624
Functions .....	624
Main Constants, Data Types and Functions—Icons .....	624
Constants .....	624
Data Types .....	626
Functions .....	626
Demonstration Program GworldPicCursIcn Listing .....	627
Demonstration Program GWorldPicCursIcn Comments .....	650
<b>14 More on Controls 661</b>	
Introduction .....	662
Preamble—Review of Control Basics .....	662
Control Descriptions .....	663
Bevel Buttons .....	663
Image Wells .....	674



Tab—Embedding Control .....	676
Edit Text .....	680
Sliders .....	682
Group Boxes—Embedding Control .....	685
Clock .....	688
Progress and Relevance Bars .....	690
Little Arrows .....	692
Disclosure Triangles .....	693
Picture .....	695
Icon .....	696
Window Headers—Embedding Control .....	698
Placard—Embedding Control .....	699
Static Text .....	700
Separator Lines .....	701
Pop-up Arrows .....	701
Radio Groups—Embedding Control .....	703
Chasing Arrows .....	704
User Panes—Embedding Control .....	705
Scrolling Text Box .....	706
Disclosure Button .....	708
Edit Unicode Text .....	708
Round Button .....	709
Small Versions of Controls .....	709
Idle Processing .....	711
Defining Your Own Key Filter Function .....	711
Example .....	712
Defining Your Own Edit Text Validation Function .....	713
Defining Your Own User Pane Functions .....	714
User Pane Functions .....	714
Control Data Tag Constants and Universal Procedure Pointers .....	716
Main Constants, Data Types and Functions .....	718
Constants .....	718
Data Types .....	724
Functions .....	725
Demonstration Program Controls3 Listing .....	728
Demonstration Program Controls3 Comments .....	778
Control3.h .....	779
Control3.c .....	779
BevellImagePictIcon.c .....	780
TabEditClock.c .....	783
GroupArrowsProgress.c .....	787
Sliders.c .....	790

TextBox.c .....	792
Callbacks.c .....	792
SmallControls.c .....	794
<b>15 Carbon Printing 795</b>	
The Carbon Printing Manager .....	796
Printing Sessions .....	796
Categories of Carbon Printing Manager Functions .....	796
Printer Drivers .....	797
Types and Characteristics of Printer Drivers .....	797
Background Printing and Spool Files .....	797
Page and Paper Rectangles .....	797
Page Rectangle .....	798
Paper Rectangle .....	798
Page Setup Dialogs and Print Dialogs .....	798
Page Setup Dialog .....	798
Print Dialog .....	799
Customized Page Setup and Print Dialogs .....	800
Preserving the User's Printing Settings .....	800
Printing Sessions—The PMPrintSession Object .....	800
The PMPageFormat and PMPrintSettings Objects .....	800
PMPageFormat Object .....	800
PMPrintSettings Object .....	803
Printing a Document .....	805
When the User Chooses Page Setup... from the File Menu .....	805
When the User Chooses Print... from the File Menu .....	805
The Printing Loop Function .....	806
Call Sequence and Scope .....	807
Handling Printing Errors .....	808
Text on the Screen and the Printed Page .....	808
Customizing the Page Setup and Print Dialogs .....	809
The PMDialog Object .....	810
Customizing a Print Dialog .....	810
Displaying Page Setup and Print Dialogs As Window-Modal (Sheet) Dialogs .....	811
Saving and Retrieving a Page Format Object .....	811
Printing from the Finder—Mac OS 8/9 .....	811
Main Carbon Printing Manager Constants, Data Types and Functions .....	812
Constants .....	812
Data Types .....	813
Functions .....	813

Demonstration Program CarbonPrinting Listing .....	815
Demonstration Program CarbonPrinting Comments .....	837
Printing.h .....	837
CarbonPrinting.c .....	838
PrintDialogAppend.c .....	844
<b>16 More on Windows 847</b>	
Introduction .....	848
Floating Windows .....	848
Floating Window Types .....	849
Opening, Closing, Showing, and Hiding Floating Windows .....	849
Functions Relating to Floating Windows .....	850
Utility and Toolbar Windows .....	850
Window Proxy Icons .....	850
Changing the State of a Proxy Icon .....	851
Handling Mouse-Down Events in a Window Proxy Icon .....	851
Proxy Icons and File Synchronization Functions .....	851
Functions Relating to Window Proxy Icons .....	852
Window Path Pop-Up Menus .....	853
Displaying and Handling a Window Path Pop-Up Menu .....	853
Transitional Window Animation and Sounds .....	854
Creating and Storing Windows .....	854
Collections, Flattened Collections, and 'wind' Resources .....	854
The CreateNewWindow Function .....	855
Accessing Window Information .....	858
Moving and Positioning Windows .....	858
Moving Windows .....	858
Positioning Windows .....	859
Associating Data with Windows .....	861
Adding To and Removing From the Update Region .....	861
Setting Content Region Color and Pattern .....	862
Window Scrolling .....	862
The Window Menu .....	863
Customizing the Window Menu .....	863
Live Window Resizing .....	863
Main Constants, Data Types, and Functions .....	864
Constants .....	864
Data Types .....	865
Functions .....	865
Demonstration Program Windows2 Listing .....	867
Demonstration Program Windows2 Comments .....	883

**17 The Carbon Event Manager 891**

Overview .....	892
The Carbon Event Model .....	892
Event Handling Basics .....	892
Event Timers .....	893
Event Reference, Class, and Type .....	893
Event Reference .....	893
Event Class and Type .....	893
Standard Event Handlers .....	894
Standard Application Event Handler .....	894
Standard Window Event Handler .....	894
The Application's Event Handlers .....	895
Handlers are Callback Functions .....	895
Installing the Application's Event Handlers .....	895
Inside The Application's Event Handlers .....	896
Handler Disposal .....	899
Sending and Explicitly Propagating Events .....	899
Sending Events .....	899
Explicitly Propagating Events .....	899
Event Timers .....	900
Getting Event Time .....	900
Other Aspects of the Carbon Event Model .....	901
The Carbon Event Model and Apple Events .....	901
Carbon Event Model and Control Hierarchies .....	901
Carbon Event Model and Event Filter Functions .....	901
Mouse Tracking .....	901
Alternative for Delay Function on Mac OS X .....	902
Main Constants, Data Types, and Functions .....	902
Constants .....	902
Data Types .....	903
Functions and Macros .....	904
Relevant Window Manager Constants and Functions .....	906
Constants .....	906
Functions .....	906
Demonstration Program CarbonEvents1 Listing .....	906
Demonstration Program CarbonEvents1 Comments .....	909
Demonstration Program CarbonEvents2 Listing .....	911
Demonstration Program CarbonEvents2 Comments .....	938
CarbonEvents2.c .....	939
Dialogs.c .....	943

**18 Files and Navigation Services 947**

Introduction .....	948
Files .....	948
Types of Files .....	948
Characteristics of Files .....	948
Creating, Opening, Reading From, Writing To, and Closing Files .....	954
File Synchronization Functions .....	963
Navigation Services .....	964
Navigation Services Dialogs and Alerts .....	964
Creating and Displaying an Open Dialog .....	966
Creating and Displaying a Save Location Dialog .....	972
Creating and Displaying a Choose a Folder Dialog .....	972
Creating and Displaying Primary Alerts .....	974
Event Handling in the Primary Dialogs .....	976
Event Handling in Primary Alerts .....	979
Other Application-Defined (Callback) Functions .....	979
Main File Manager Constants, Data Types and Functions .....	980
Constants .....	980
Data Types .....	981
Functions .....	981
Relevant Resource Manager Functions .....	982
Relevant Finder Interface Functions .....	982
Main Navigation Services Constants, Data Types, and Functions .....	983
Constants .....	983
Data Types .....	984
Functions .....	985
Demonstration Program Files Listing .....	987
Demonstration Program Files Comments .....	1029
Files.h .....	1030
Files.c .....	1031
NewOpenCloseSave.c .....	1034
SynchroniseFiles.c .....	1046
ChooseAFolderDialog.c .....	1048

**19 More on Resources and Core Foundation Preferences 1049**

Introduction .....	1050
Search Path for Resources .....	1050
Preamble .....	1050
Current Resource File .....	1051
Default Search Order .....	1051



Setting the Current Resource File To Dictate the	
Search Order .....	1052
Restricting the Search to the Current Resource File .....	1052
Releasing and Detaching Resources .....	1052
Creating, Opening, and Closing Resource Forks .....	1052
Opening an Application's Resource Fork .....	1052
Creating and Opening a Resource Fork .....	1053
Reading and Manipulating Resources .....	1054
Reading From the Resource Map Without Loading	
the Resource .....	1054
Indexing Through Resources .....	1054
Writing Resources .....	1054
Care with Purgeable Resources .....	1055
Partial Resources .....	1055
Application Preferences .....	1055
Using Core Foundation Preferences Services .....	1055
Main Resource Manager Constants, Data Types and Functions .....	1057
Constants .....	1057
Data Types .....	1057
Functions .....	1057
Main Core Foundation Preferences Services Functions .....	1058
Demonstration Program MoreResources Listing .....	1059
Demonstration Program MoreResources Comments .....	1082
<b>20 Carbon Scrap 1093</b>	
The Carbon Scrap Manager and the Scrap .....	1094
Introduction .....	1094
Location of the Scrap .....	1094
Scrap Reference .....	1094
Scrap Flavors .....	1095
Implementing Edit Menu Commands .....	1095
Clipboard Windows .....	1098
Transferring the Scrap to Disk —Mac OS 8/9 .....	1098
Main Carbon Scrap Manager Functions .....	1099
Private Scrap .....	1100
Additional Actions—Old Scrap Manager .....	1100
Additional Actions—Carbon Scrap Manager .....	1101
TextEdit, Dialogs, and Scrap .....	1103
TextEdit and Scrap .....	1103
Dialogs and Scrap .....	1103

Main Carbon Scrap Manager Constants, Data Types, and Functions .....	1104
Constants .....	1104
Data Types .....	1104
Functions .....	1105
Demonstration Program CarbonScrap Listing .....	1105
Demonstration Program CarbonScrap Comments .....	1125
<b>21 Text, Textedit, Dates, Times, and Numbers 1133</b>	
Introduction .....	1134
More on Text .....	1134
Characters and Character Sets and Codes .....	1134
Glyphs .....	1135
Typefaces .....	1135
Styles .....	1136
Fonts and Font Families .....	1136
Font Measurements .....	1136
The Font Manager and QuickDraw .....	1137
Caret Position and Text Offset .....	1137
Converting Screen Position to Text Offset .....	1138
Selection Range and Insertion Points .....	1138
Highlighting .....	1139
Keyboards and Text .....	1139
Introduction to TextEdit .....	1139
Editing Tasks Performed by TextEdit .....	1139
TextEdit Options .....	1140
Caret Position and Movement in TextEdit .....	1141
Automatic Scrolling .....	1141
TextEdit's Private, Null, and Style Scraps .....	1141
Text Alignment .....	1141
Primary TextEdit Data Structures .....	1142
Monostyled TextEdit .....	1145
Creating, and Disposing of, a Monostyled TextEdit Structure .....	1145
Setting the Text .....	1146
Responding to Events .....	1147
Caret Blinking .....	1148
Cutting, Copying, Pasting, Inserting, and Deleting Text .....	1148
Setting the Selection Range or Insertion Point .....	1150
Enabling, Disabling, and Customising Automatic Scrolling .....	1150
Scrolling Text .....	1150
Setting Text Alignment .....	1151
Saving and Opening TextEdit Documents .....	1151

Multistyled TextEdit .....	1151
Text With Multiple Styles—Style Runs, Text Segments,	
Font Runs, Character Attributes .....	1151
Additional TextEdit Data Structures for Multistyled Text .....	1152
Creating a Multistyled TextEdit Structure .....	1152
Inserting Text .....	1152
Formatting and Displaying Dates, Times, and Numbers .....	1154
Preamble—The Text Utilities and International Resources .....	1154
Date and Time .....	1155
Numbers .....	1158
Main TextEdit Constants, Data Types and Functions .....	1162
Constants .....	1162
Data Types .....	1162
Functions .....	1164
Main Constants, Data Types and Functions Relating to	
Dates, Times and Numbers .....	1165
Constants .....	1165
Data Types .....	1165
Functions .....	1166
Demonstration Program MonoTextEdit Listing .....	1167
Demonstration Program MonoTextEdit Comments .....	1204
MonoTextEdit.c .....	1205
HelpDialog.c .....	1214
Demonstration Program DateTimeNumbers Listing .....	1220
Demonstration Program DateTimeNumbers Comments .....	1232
<b>22 Lists and Custom List Definition Functions 1237</b>	
Introduction to Lists .....	1238
List Manager Limitations .....	1238
Options for Creating and Managing Lists .....	1238
Appearance and Features of Lists .....	1238
Cells .....	1239
Cell Font .....	1239
Cell HighLighting .....	1239
Scroll Bars .....	1240
Selection of Cells Using the Mouse .....	1240
LClick .....	1240
Multiple Cell Selection Using the Default Cell-	
Selection Algorithm .....	1240
Customizing the Cell-Selection Algorithm .....	1241
Selection of Cells Using the Keyboard .....	1241
Cell Selection Using Arrow Keys .....	1241
Type Selection .....	1242

Creating, Disposing of, and Managing Lists .....	1243
The List Structure .....	1243
Creating Lists .....	1248
Disposing of a List .....	1249
Adding Rows and Columns to a List .....	1249
Disabling and Enabling the Automatic Drawing Mode .....	1250
Responding to Events in a List .....	1250
Getting and Setting List Selections .....	1251
Scrolling a List .....	1251
Storing Data .....	1251
Adding to Data .....	1251
Getting Cell Data .....	1252
Clearing Data .....	1252
Searching a List .....	1252
Changing the Current List .....	1252
Customizing the Cell-Selection Algorithm .....	1253
The List Box Control .....	1254
List Box Variants, Values, Constants, and Resources .....	1255
Custom List Definition Functions .....	1257
Messages Sent by List Manager .....	1257
Main List Manager Constants, Data Types, and Functions .....	1259
Constants .....	1259
Data Types .....	1259
Functions .....	1260
Relevant Text Utilities Data Type and Functions .....	1262
Data Type .....	1262
Functions .....	1262
Demonstration Program Lists Listing .....	1262
Demonstration Program Lists Comments .....	1290
Lists.h .....	1291
Lists.c .....	1292
WindowList.c .....	1292
DialogList.c .....	1305
<b>23 Drag and Drop 1307</b>	
Overview .....	1308
The Drag Manager .....	1308
The Three Phases of a Drag .....	1308
Drag Items, Drag Item Flavors, and Handlers .....	1309
Drag Items and Item Reference Numbers .....	1309
Drag Item Flavors .....	1310
Drag Handlers .....	1311

The Drag Region and The Drag Image .....	1313
Creating the Drag Region .....	1313
Setting the Drag Image—Translucent Drags .....	1313
Drag Functions—Overriding Drag Manager Default Behavior .....	1314
Drawing Function .....	1315
Send Data Function .....	1315
Drag Input Function .....	1315
Main Drag Manager Constants, Data Types, and Functions .....	1315
Constants .....	1315
Data Types .....	1316
Functions .....	1316
Relevant TextEdit Function .....	1318
Demonstration Program Drag Listing .....	1318
Demonstration Program Drag Comments .....	1356
Drag.h .....	1356
Drag.c .....	1357
StartAndTrackDrag.c .....	1358
ReceiveAndUndoDrag.c .....	1362
<b>24 Basic Sound and Speech 1367</b>	
Introduction to Sound .....	1368
Audio Hardware and Sound-Related System Software .....	1368
Sound Input and Output Capabilities .....	1368
Basic and Enhanced Sound Capabilities .....	1369
Sound Data .....	1369
Sampled Sound .....	1369
Sound Components .....	1370
Sound Resources .....	1370
Sound Production .....	1371
Sound Channels .....	1371
Sound Commands .....	1371
Synchronous and Asynchronous Sound .....	1373
Playing a Sound .....	1373
Sound Recording—Mac OS 8/9 .....	1374
Recording a Sound Resource .....	1375
Recording Quality .....	1375
Speech .....	1375
Generating Speech From a String .....	1376
Relevant Constants, Data Types, and Functions .....	1376
Constants .....	1376
Data Types .....	1376
Functions .....	1377

The AsynchSoundLib Library .....	1377
AsynchSoundLib Functions .....	1378
Demonstration Program SoundAndSpeech Listing .....	1381
Demonstration Program SoundAndSpeech Comments .....	1391
<b>25 Miscellany 1397</b>	
Notification From Applications in the Background .....	1398
The Need for the Notification Manager .....	1398
Elements of a Notification .....	1398
Notifications in Action .....	1399
Progress Bars Command-Period Key-Down Events, and Mouse-Down Events .....	1401
Progress Bars .....	1401
Scanning for Command-Period Key-Down Events .....	1402
The Color Picker .....	1402
Color Models .....	1402
The Color Picker .....	1403
Coping with Multiple Monitors .....	1405
Overview .....	1405
Requirements of the Application .....	1406
Constraining a Window to One Screen .....	1407
Help Tags .....	1407
Human Interface Guidelines .....	1408
Creating Help Tags .....	1408
Setting the Delay Before Tag Display .....	1410
Enabling and Disabling Help Tags .....	1410
Ensuring Compatibility with the Operating Environment .....	1410
The Gestalt Function .....	1410
Carbon and Available APIs .....	1413
CarbonLib and the Underlying Mac OS 8/9 System Software .....	1413
Interpreting Universal Headers Comments .....	1413
T-Vector Tests .....	1414
Main Notification Manager Data Types and Functions .....	1414
Data Types .....	1414
Functions .....	1415
Relevant Process Manager Data Types and Functions .....	1415
Data Types .....	1415
Functions .....	1415
Relevant Event Manager Function .....	1415
Relevant Color Picker Utilities Function .....	1415
Relevant QuickDraw Function .....	1415



Relevant Window Manager Function .....	1416
Main Help Package Constants, Data Types, and Functions .....	1416
Constants .....	1416
Data Types .....	1417
Functions .....	1417
Relevant Gestalt Manager Function .....	1418
Demonstration Program Miscellany Listing .....	1418
Demonstration Program Miscellany Comments .....	1434
Miscellany.c .....	1435
Notification.c .....	1436
ProgressBar.c .....	1438
ColorPicker.c .....	1438
MultiMonitor.c .....	1439
HelpTag.c .....	1439
<b>26 More on Text—Multilingual Text Engine 1441</b>	
Introduction .....	1442
Global Layout Settings .....	1442
Undoable and Re-doable Actions .....	1443
Selection Behavior .....	1443
File Types .....	1443
Working with MLTE .....	1444
Initializing and Terminating MLTE .....	1444
Allocating and Deleting a TXNObject .....	1444
Setting and Getting Global Layout Settings .....	1446
Setting the Background .....	1448
Setting and Getting Type Attributes .....	1448
Functions Relevant to Events .....	1450
Functions Relevant to the File Menu .....	1451
Functions Relevant to the Edit Menu .....	1452
Creating, Preparing, and Handling the Font Menu .....	1454
Setting Data .....	1454
Main Constants, Data Types, and Functions .....	1455
Constants .....	1455
Data Types .....	1457
Functions .....	1458
Demonstration Program MLTETextEditor Listing .....	1461
Demonstration Program MLTETextEditor Comments .....	1500
MLTETextEditor.c .....	1501
MLTEMenus.c .....	1504
MLTENewOpenCloseSave.c .....	1508
<b>Index 1513</b>	

# About the Author

K. J. Bricknell is a retired officer of the Royal Australian Air Force. His service career included flying duties in fighter squadrons and flying training units, together with staff duties associated with operational requirements, air training, and Air Force policy and plans at the Australian Department of Defense. His commands included No 3 (Fighter) Squadron and the Aircraft Research and Development Unit. An amateur programmer for many years, he is the author of *Macintosh C: A Hobbyist's Guide to Programming the Macintosh in C*, which was published on the Internet in 1996.

# Dedication

*To Janice, Samantha, Stephen, Bessie, and Kellie.*

# Tell Us What You Think!

As the reader of this book, *you* are our most important critic and commentator. We value your opinion and want to know what we're doing right, what we could do better, what areas you'd like to see us publish in, and any other words of wisdom you're willing to pass our way.

As an Executive Editor for Sams Publishing, I welcome your comments. You can e-mail or write me directly to let me know what you did or didn't like about this book—as well as what we can do to make our books stronger.

*Please note that I cannot help you with technical problems related to the topic of this book, and that due to the high volume of mail I receive, I might not be able to reply to every message.*

When you write, please be sure to include this book's title and author as well as your name and phone or fax number. I will carefully review your comments and share them with the author and editors who worked on the book.

E-mail:     [feedback@sampublishing.com](mailto:feedback@sampublishing.com)

Mail:        Jeff Schultz  
              Sams Publishing  
              201 West 103rd Street  
              Indianapolis, IN 46290 USA

# Introduction—The Carbon Application Programming Interface

Apple announced the intended introduction of a new operating system, to be known as Mac OS X, at the 1998 World Wide Developers Conference. Mac OS X, the first version of which was released on 24 March 2001, is not just another Mac OS update; it is a completely new operating system complete with “modern” operating system features such as pre-emptive multitasking and protected memory. It features a completely new user interface, called Aqua, whose appearance and behavior differs significantly from that of the original Mac OS (represented in its latest, and no doubt last, incarnation by Mac OS 9).

Mac OS X runs on G3 and G4 PowerPC machines only, meaning that machines based on PowerPC 604 and 603 microprocessors must necessarily remain with Mac OS 9 and earlier. A large installed base of these latter machines will no doubt remain for many years to come. In addition, it is likely that many owners of machines capable of running Mac OS X will nonetheless remain with Mac OS 9 and earlier. In these circumstances, it was perceived as all but essential that programs written to take advantage of Mac OS X’s advanced features also be capable of running on Mac OS 8 and 9 without modification. Fortunately, Apple has devised the means whereby this can be achieved, namely, the Carbon Application Programming Interface (API).

An API is basically a collection of system software routines, two examples being `GetNewCWindow` (which programmers call to create windows) and `FSpOpenDF` (which programmers call to open a file). Mac OS 9 includes a collection of more than 8,000 such system software routines, which are now known collectively as the Classic API. Apple determined that about 2000 of these APIs were incompatible with a modern operating system like Mac OS X. The remaining 6,000 or so “clean” APIs were isolated and, together with a many additions, included in the Carbon API.

It turns out, therefore, that experienced Macintosh programmers will not need to learn a completely new API in order to program for the completely new operating system that is Mac OS X. Any programmer familiar with the Classic API will be able to transition to the Carbon API with comparatively little effort. In addition, newcomers to Macintosh programming will not be required to learn two APIs in order to write applications intended to run native on both Mac OS X and Mac OS 8 and 9.

That said, there is another API, called Cocoa, that may be used to write programs for Mac OS X. Cocoa’s advantage is that it allows applications to be written more quickly than is the case using the Carbon API; however, such applications will not run on Mac OS 8 and 9.

A further advantage of Carbon is that existing applications written using the Classic API can be “carbonized” with but a fraction of the effort that would be required to completely rewrite them for Mac OS X using the Cocoa API.

This book, then, is for those who wish to learn to create applications that will run on both Mac OS X and Mac OS 8 and 9 and take advantage of Mac OS X’s unique features when run on that system. It is intended as a reasonably comprehensive entry point to programming the Macintosh using the Carbon API.

## The First Task—Learn the C Language and CodeWarrior IDE

The main assumption made by this book is that you have already learned both the C language and the Metrowerks CodeWarrior IDE (Integrated Development Environment) (<http://www.metrowerks.com/platforms/mactools/>).

CodeWarriorU (<http://www.codewarrioru.com/CodeWarriorU>) conducts on-line courses in the C language and the CodeWarrior IDE.

## The Carbon Programming Phase

When you have learned the C language and the fundamentals of the CodeWarrior IDE, you are ready to open this book. As you move through this second phase of the journey, you will quickly discover that learning C and the IDE was by far the easiest part!

Essentially, this book covers all of the territory which, in the author’s judgment, needs to be covered before you write your first serious application. This includes, for example, how to create and manage all elements of the user interface (menus, windows, controls, dialogs, alerts, lists, drag and drop), how to perform file input/output, how to print documents, how to draw text and graphics, and so on.

## General Structure of Carbon Programming

The general structure of most chapters in this book is the same: first comes the information; then a list of constants, data types, and functions relevant to the subject of that chapter; then the source code listing of one or more demonstration programs related to the subject of that chapter; and, finally, line-by-line comments that explain the workings of the source code.

The book itself is supported by the Web site, which contains the CodeWarrior project and source code files, and Resorcerer resource files, for all demonstration programs. The demonstration programs associated with Chapters 18 to 25 exist in two versions:

- The primary version, which utilizes the Carbon event model introduced at Chapter 17, is the version whose source code listing and associated comments are included in the book itself.
- The secondary version utilizes the Classic event model (see Chapter 2). The explanatory comments for this version are contained in PDF files included in the relevant demonstration program (Classic event model version) folders.

## What You Will Need

### System Software

For Mac OS 8 and 9, Carbon Programming requires

- CarbonLib 1.4 or later. CarbonLib is the extension, located in the Extensions folder in the System folder, that implements the Carbon API on Mac OS 8 and 9.
- Mac OS 8.6 or later. CarbonLib 1.4 is not compatible with versions of Mac OS 8 earlier than 8.6.

For Mac OS X, Version 10.0.3 or later is required. (The so-called frameworks that implement the Carbon API on Mac OS X are an integral part of Mac OS X and are installed when you install that system. Frameworks are like shared libraries on Mac OS 8/9.)

### Development System

As previously stated, it is assumed that your development system will be Metrowerks CodeWarrior. CodeWarrior Pro 6 (or later) is itself a Carbon application, and is much to be preferred.

### Resource Editor

A resource editor allows you to create resources for programs and files. The resource editor you will need is Resorcerer, a product of Mathemaesthetics (<http://www.mathemaesthetics.com/index.html>).

### References and Other Sources of Information

References enable you to access information relating to the system software, and are quite indispensable. The Carbon Developer Documentation section and the Mac OS 8 and 9 Developer Documentation Function Index (<http://developer.apple.com/techpubs/macosx/Carbon/carbon.html> and <http://developer.apple.com/techpubs/FunctionIndex/FunctionIndex.html>) at Apple's WWW site are the most up-to-date sources of information available. You might also wish to subscribe to Apple's Carbon development mailing list (<http://www.lists.apple.com/mailman/listinfo/carbon-development>).



## Programmer's Calculator

You will find a programmer's calculator very useful for converting between decimal, hexadecimal, and binary values, the shareware program CalcWorks (<http://sitelink.net/jbrochussoftware>) being ideal for that purpose.

## Icon Editor

Versions of Resorcerer earlier than Version 2.4 did not facilitate the creation of 32-bit icons or the large (128-by-128 pixel) thumbnail icons utilized by Mac OS X. If your version of Resorcerer is earlier than Version 2.4, the shareware program Iconographer (<http://www.mscape.com/products/iconographer.html>) is possibly the best option for the creation of these icons.

## Universal Headers, CarbonLib, and Stub Libraries

The demonstration programs on the Web site assume the use of Version 3.4.1 or later of the Universal Headers and, as previously stated, CarbonLib 1.4 or later.

The Universal Headers were introduced at the same time as the Power Macintosh. Among other things, they enabled programmers to write (Classic API) source code capable of being compiled as either 680x0 code or PowerPC code—hence the term “Universal.”

If the version of CodeWarrior you are using includes an earlier version of the Universal Headers and/or the version of CarbonLib in your Mac OS 8/9 Extensions folder is earlier than 1.4 (or does not exist), you should download the CarbonLib SDK (Software Development Kit) Version 1.4GM (or later) from <http://developer.apple.com/carbon/> and

- Replace the existing folder CIncludes in Metrowerks CodeWarrior / Mac OS Support / Universal / Interfaces with the one in the SDK
- Copy the extension CarbonLib from the SDK to the Mac OS 8/9 Extensions folder, replacing the existing version if it exists
- Copy the two stub libraries CarbonLib and CarbonFrameWorkLib from the SDK to Metrowerks CodeWarrior / Mac OS Support / Universal / Libraries / StubLibraries, replacing the existing versions if they exist

## Human Interface Guidelines—Mac OS 8/9

Useful additions to your library when you get further down the track would be the publications

- Macintosh Human Interface Guidelines and Mac OS 8 Human Interface Guidelines (<http://developer.apple.com/techpubs/mac/HIGuidelines/HIGuidelines-2.html>).
- Inside Mac OS X—Aqua Human Interface Guidelines (<http://developer.apple.com/techpubs/macosx/macosx.html>).

## Demonstration Programs

For Mac OS 8/9, you should simply copy the folder Carbon Programming Demos from the Web site to a convenient location on your hard drive. For Mac OS X, you should copy the folder titled Carbon Programming Demos to the Applications folder and the folder titled Carbon Programming Documents to the relevant user's Documents folder.

Before running a demonstration program, you should read the top section of the source code comments in the relevant chapter (or, for the post-Chapter 17 Classic event model versions, in the previously mentioned PDF files). For most programs, this explains what to do, what to expect, and what to note. Note that the comments sections occasionally contain additional information incidental to the main purpose of the demonstration.

As far as is possible, each demonstration program avoids making calls to system software routines that are only explained in a later chapter. However, achieving that ideal has not been possible in the demonstration programs associated with the earlier chapters. For example, the demonstration program associated with Chapter 1 must, of necessity, make calls to system software routines relating to windows (the subject of Chapter 4) and drawing in a graphics port (the subject of Chapter 12). Where this occurs, you should simply accept, on faith, that the associated source code does as is stated in the demonstration program comments section. The important thing is to concentrate on that part of the source code pertaining to the subject of the chapter with which the program is associated.

## Terminology

All but the later volumes of the official Mac OS reference work (Inside Macintosh) are Pascal-oriented, reflecting the fact that system software routines were originally designed to be called from a Pascal program. Because of this historically cosy relationship between Pascal and the Mac OS 8/9 system software, the C programmer will often be confronted by Pascal terminology. For example

- The Pascal terms “procedure” and “record” are sometimes used in C-oriented programming books and other publications in a context where the C programmer would ordinarily expect the terms “function” and “structure.”
- In C, a routine which returns a value and a routine which does not return anything are both called **functions**. In Pascal, a routine which returns a value is also called a **function**; however, a routine which does not return anything is called a **procedure**.
- The names of many system software data structures end in Rec (for record) rather than, say, Struc (for structure).
- The names of certain fields in many system software data structures end in Proc (for procedure) rather than, say, Func (for function).

As a reflection of the fact that the later additions to Apple's Inside Macintosh series of publications are C-oriented rather than Pascal-oriented, this book uses C terminology exclusively. Hence "structure" is used rather than "record" and "function" is used rather than "procedure."

## Early Days

This book was sent to press during the early days of both Mac OS X and the Mac OS 8/9 Carbon implementation. At that time, both systems contained bugs which affected some of the demonstration programs. Known issues in this regard, for which the author begs the reader's indulgence, are listed in the ReadMe file on the Web site.

In these circumstances, the reader is advised to periodically check the Carbon Programming updates site at [www.sampublishing.com](http://www.sampublishing.com) for updated text and code.

K. J. Bricknell, AM  
Canberra, Australia  
[brick@asiaonline.net.au](mailto:brick@asiaonline.net.au)

# System Software, PowerPC Run-Time Environment, Managing Memory, and Resources

## CHAPTER

# 1

## IN THIS CHAPTER

- System Software 2
- PowerPC Run-Time Environment 4
- Managing Memory—Mac OS 8/9 6
- Managing Memory—Mac OS X Considerations 15
- Main Memory Manager Data Types and Functions 26
- Main Resource Manager Constants, Data Types, and Functions 27
- Demonstration Program SysMemRes Listing 28
- Demonstration Program SysMemRes Comments 31

## System Software

All Macintosh applications make many calls, for many purposes, to **system software functions**. Such purposes include, for example, the creation of standard user interface elements such as windows and menus, the drawing of text and graphics, and the coordination of the application's actions with other open applications.

### NOTE

The main *other* open application that an application needs to work with is the **Finder**. The Finder is not really part of the system software, although it is sometimes difficult to tell where the Finder ends and the system software begins.

The entire collection of system software functions is divided into functional groups known as **managers**. In Carbon, each manager is part of a higher-level grouping called a **manager group**. The manager groups and their constituent managers are shown in the following, in which those managers of particular relevance to this book appear in bold typeface:

**Application Utilities** Facilities for extending human interface features and data-sharing capabilities beyond those provided by the Human Interface Toolbox.

AltiVec Utilities	Find By Content	Translation Manager
-------------------	-----------------	---------------------

**Carbon Core** Essential services that are generally devoid of a user interface, including memory and process management.

<b>Alias Manager</b>	<b>Collection Manager</b>	Component Manager	<b>File Manager</b>
<b>Folder Manager</b>	<b>Low Memory Accessors</b>	Memory Management Utilities	<b>Memory Manager</b>
<b>Mixed Mode Manager</b>	Multiprocessing Services	<b>Notification Manager</b>	Pascal String Utilities
<b>Resource Manager</b>	Thread Manager	Time Manager	

### Common OS Services

Display Manager	<b>Gestalt Manager</b>	Power Manager	<b>Process Manager</b>
Speech Recognition Manager	<b>Speech Synthesis Manager</b>		



**Core Foundation** Abstracts several operating system utilities fundamental to both Mac OS 8/9 and Mac OS X.

Base Services	Bundle Services	Collection Services	Plug-in Services
<b>Preferences Services</b>	<b>Property List Services</b>	<b>String Services</b>	URL Services
Utility Services	XML Services		
<b>Graphics Services</b>	Allows applications to construct and render images.		
<b>Carbon Printing Manager</b>	<b>Color Picker Manager</b>	ColorSync Manager	HTML Rendering Library
<b>Palette Manager</b>	<b>QuickDraw Manager</b>		

**Hardware Interfaces**

Device Manager	PCI Card Services
----------------	-------------------

**Human Interface Toolbox** Comprises groups of libraries that implement the Mac OS human interface.

<b>Appearance Manager</b>	<b>Apple Help</b>	<b>Carbon Event Manager</b>	<b>Carbon Help Manager</b>
<b>Control Manager</b>	<b>Dialog Manager</b>	<b>Drag Manager</b>	<b>Event Manager</b>
<b>Finder Interface</b>	<b>Icon Utilities</b>	<b>List Manager</b>	<b>Menu Manager</b>
<b>Navigation Services</b>	<b>Picture Utilities</b>	<b>Scrap Manager</b>	<b>Window Manager</b>

**Networking and Communication Services**

Internet Config	NSL manager	Open Transport	URL Access Manager
-----------------	-------------	----------------	--------------------

**QuickTime** Assist your application in combining multiple forms of communication, such as text, pictures, video, and music.

Image Compression Manager	Media Handlers	Movie Toolbox	QuickTime Components
QuickTime Media Layer	QuickTime Music	QuickTime Streaming	QuickTime VR
<b>Sound Manager</b>			



**Runtime Services** Provides programming interfaces that prepare code for execution and control how functions call each other.

<b>Code Fragment Manager</b>	Debugger Services	Math and Logical Utilities
------------------------------	-------------------	----------------------------

#### Scripting and Apple Events

<b>Apple Event Manager</b>	Open Scripting Architecture
----------------------------	-----------------------------

**Text and Other International Services** Assistance in creating applications for world-wide markets

Apple Type Services for Unicode Imaging	<b>Date, Time, and Measurement Utilities</b>	<b>Font Manager</b>
FontSync	<b>Multilingual Text Engine</b>	<b>QuickDraw Text</b>
Script Manager	Text Encoding Conversion Manager	Text Services Manager
<b>Text Utilities</b>	<b>TextEdit</b>	Unicode Utilities

## PowerPC Run-Time Environment

A run-time environment is a set of conventions that determines how code is to be loaded into memory, where it is to be stored, how it is to be addressed, and how functions call other functions and system software routines. The system software and your development system jointly determine the run-time environment.

### Fragments

The PowerPC run-time model is based on the use of **fragments** as the standard way of organizing executable code and data in memory. A fragment is any block of executable PowerPC code and its associated data. Fragments can be of any size, and are complete, executable entities.

There are three broad categories of fragments, namely, **applications**, **import libraries**, and **extensions**. (Import libraries and system extensions are sometimes called **shared libraries** or **dynamically-linked libraries**.) An application is a fragment that can be launched by the user from the Finder.

## Code Fragment Resource

You use a code fragment ('cfrg') resource (see Resources, later in this chapter) to specify some characteristics of a code fragment. For an application, the code fragment resource indicates to the Process Manager that the application's data fork contains an executable code fragment container.

You do not have to create the 'cfrg' resource yourself because CodeWarrior does this for you when you compile your application.

## Organization of Memory

The basic organization of memory in the PowerPC run-time environment is as follows:

- A **system partition**, which is reserved for the exclusive use of the system, occupies the lowest memory address. Part of the system partition is occupied by the system global variables, most of which contain information of use to the system software, for example:
  - Ticks, which contains the number of ticks since system startup. (A tick is 1/60th of a second.)
  - MBarHeight, which contains the height of the menu bar.
- Most of the remaining space is allocated to the Process Manager, which creates an **application partition** for each open application. Application partitions are loaded into the top part of RAM first.

## The Application Partition

In each application partition, there is a **stack** and a **heap**, as well as space for the application's **global variables** (see Fig 1).

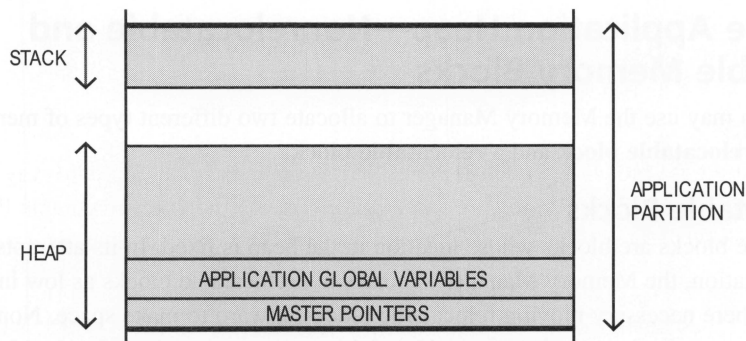


FIG 1 - STRUCTURE OF APPLICATION PARTITION

## The Stack

The stack is used for memory allocation associated with the execution of functions. When an application calls a function, space is allocated on the stack for a **stack frame**, which contains the function's parameters, local variables and return address. The local variables and function parameters are popped off the stack when the function has executed. The C compiler generates the code that creates and deletes stack frames for each function call.

It is important to understand that the Memory Manager has no way of preventing the stack from encroaching on, and corrupting, the heap. Ordinarily, unless your application uses heavy recursion (one function repeatedly calling itself), you almost certainly will never need to worry about the possibility of stack overflow.

### NOTE

The reason that recursion increases the risk is that, each time the function calls itself, a *new* copy of that function's parameters and variables is pushed onto the stack.

## The Heap

The application heap is that part of the application partition in which memory is dynamically allocated and released on demand. Space within the heap is allocated, in blocks, by both direct or indirect calls to the Memory Manager. An indirect allocation arises from a call to a function which itself calls a Memory Manager memory allocation function.

# Managing Memory—Mac OS 8/9

## Inside the Application Heap—Nonrelocatable and Relocatable Memory Blocks

An application may use the Memory Manager to allocate two different types of memory blocks: a **nonrelocatable block** and a **relocatable block**.

### Nonrelocatable Blocks

Nonrelocatable blocks are blocks whose location in the heap is fixed. In its attempts to avoid heap fragmentation, the Memory Manager allocates nonrelocatable blocks as low in the heap as possible, where necessary moving relocatable blocks upward to make space. Nonrelocatable blocks are referenced using a **pointer** variable of data type `Ptr`. `Ptr` is defined as follows:

```
typedef char *Ptr; // A pointer to a signed char.
```

A pointer is simply the address of a byte in memory. Thus a pointer to a nonrelocatable block is simply the address of the first byte in that block of memory. Note that if a copy is made of the pointer variable after the block is created, and since the block cannot be moved, that copy will correctly reference the block until it is disposed of.

The Memory Manager function `NewPtr` allocates a nonrelocatable block, for example:

```
Ptr myPointer;  
myPointer = NewPtr(sizeof(myDataStructure));
```

Nonrelocatable blocks are disposed of by a call to `DisposePtr`.

Unlike relocatable blocks, there are only five things that your application can do with a nonrelocatable block: create it; obtain its size; resize it; find which heap zone owns it; dispose of it.

## Relocatable Blocks

Relocatable blocks are blocks that can be moved within the heap—for example, during heap compaction operations. To reference relocatable blocks, the Memory Manager uses **double indirection**, that is, the Memory Manager keeps track of a relocatable block with a **master pointer**, which is itself part of a nonrelocatable **master pointer block** in the application heap. When the Memory Manager moves a relocatable block, it updates the master pointer so as to ensure that the master pointer always contains the current address of the relocatable block.

One master pointer block, which contains 64 master pointers, is allocated for your application by the Memory Manager at application launch. This block is located at the very bottom of the application heap (see Fig 1). The function `MoreMasterPointers` may be called by your application to allocate additional master pointers. To ensure that these additional (nonrelocatable) blocks are allocated as low in the heap as possible, the call to `MoreMasterPointers` should be made at the beginning of your program.

### NOTE

If these calls are not made, the Memory Manager will nonetheless automatically allocate additional blocks during application execution if required. However, since master pointer blocks are nonrelocatable, such allocation, which will not be at the bottom of the heap, is a possible cause of heap fragmentation. Your call to `MoreMasterPointers` should thus allocate sufficient master pointers to ensure that the Memory Manager never needs to create additional master pointer blocks for you. (You can empirically determine how many master pointers to allocate using a low-level debugger.)

Relocatable blocks are referenced using a **handle** variable of data type `Handle`. A handle contains the address of a master pointer, as illustrated in Fig 2. `Handle` is defined as follows:

```
typedef Ptr *Handle; // A pointer to a master pointer.
```

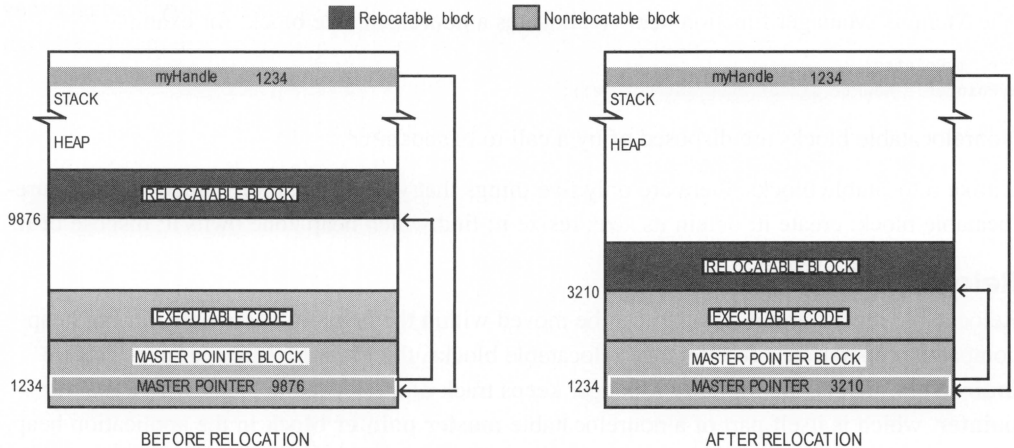


FIG 2 - A HANDLE TO A RELOCATABLE BLOCK

The Memory Manager function `NewHandle` allocates a relocatable block, for example:

```
Handle myHandle;  
myHandle = NewHandle(sizeof(myDataStructure));
```

A relocatable block can be disposed of by a call to `DisposeHandle`. Note, however, that the Memory Manager does not change the value of any handle variables that previously referenced that deallocated block. Instead, those variables still hold the address of what was once the relocatable block's master pointer. If you inadvertently use a handle to a block you have already disposed of, your application could crash. You can avoid these problems by assigning the value `NULL` to the handle variable after you dispose of the relocatable block.

## Heap Fragmentation, Compaction, and Purging

The continuous allocation and release of memory blocks which occurs during an application's execution can result in a condition called **heap fragmentation**. The heap is said to be fragmented when nonrelocatable blocks or **locked relocatable blocks** (see the next section) are scattered about the heap, leaving "holes" of memory between those blocks.

The Memory Manager continuously attempts to create more contiguous free memory space through an operation known as **heap compaction**, which involves moving all relocatable blocks as low in the heap as possible. However, because the Memory Manager cannot move relocatable blocks “around” nonrelocatable blocks and locked relocatable blocks, such blocks act like log-jams if there is free space below them. In this situation, the Memory Manager may not be able to satisfy a new memory allocation request because, although there may be enough total free memory space, that space is broken up into small noncontiguous blocks.

Heap fragmentation would not occur if all memory blocks allocated by the application were free to move during heap compaction. However, there are two types of memory block which are not free to move: nonrelocatable blocks and relocatable blocks that have been temporarily locked in place.

## Locking and Unlocking Relocatable Blocks

Despite the potential of such action to inhibit the Memory Manager’s heap compaction activities, it is nonetheless necessary to lock relocatable blocks in place in certain circumstances.

For example, suppose you dereference a handle to obtain a pointer (that is, a *copy* of the master pointer) to a relocatable block and, for the sake of increased speed, use that pointer within a loop to read or write data to or from the block. If, within that loop, you call a function that has the potential to move memory, and if that function actually causes the relocatable block to be moved, the master pointer will be correctly updated but your copy (the pointer) will not. The net result is that your pointer no longer points to the data and becomes what is known as a **dangling pointer**. This situation is illustrated at Fig 3.

### NOTE

Accessing a relocatable block by double indirection (that is, through its handle) instead of by single indirection (ie, through its master pointer) requires an extra memory reference.

The documentation for system software functions indicates whether a particular function has the potential to move memory. Generally, any function that allocates space from the application heap has this potential. If such a function is not called in a section of code, you can safely assume that all blocks will remain stationary while that code executes.



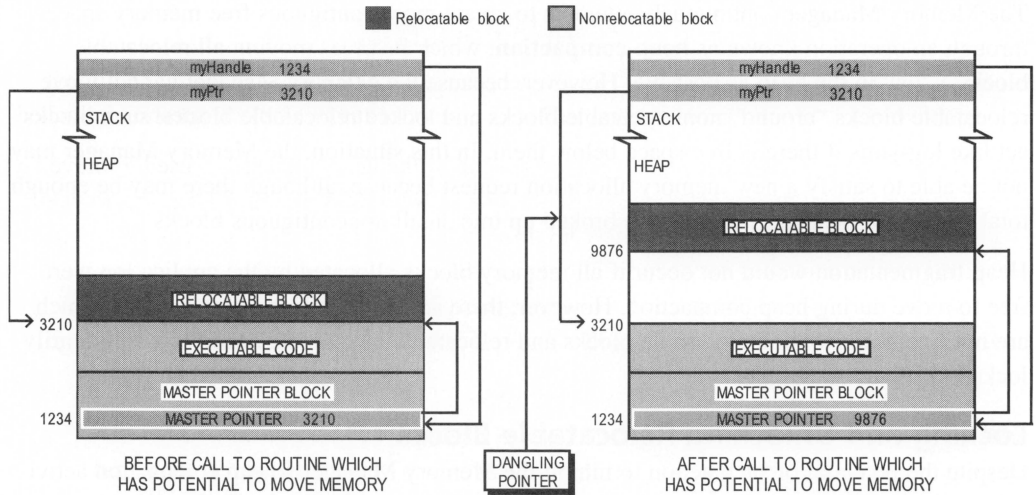


FIG 3 - A DANGLING POINTER

Relocatable blocks may be locked and unlocked using `HLock` and `HUnlock`. The following example illustrates the use of these functions.

```
typedef struct
{
    short intArray[1000];
    char ch;
} Structure, *StructurePointer, **StructureHandle;

void myFunction(void)
{
    StructureHandle theHdl;
    StructurePointer thePtr;
    short count;

    theHdl = (StructureHandle) NewHandle(sizeof(Structure));

    HLock(theHdl);                // Lock the relocatable block ...
    thePtr = *theHdl;             // because the handle has been dereferenced ...

    for(count=0; count<1000; count++)
    {
        (*thePtr).intArray[count] = 0; // and used in this loop ...
        DrawChar((char)'A');           // which calls a function which could cause
    }                                  // the relocatable block to be moved.

    HUnlock(theHdl);              // On loop exit, unlock the relocatable block.
}
```

## Moving Relocatable Blocks High

The potential for a locked relocatable block to contribute to heap fragmentation may be avoided by moving the block to the top of the heap before locking it. This should be done if new nonrelocatable blocks are to be allocated while the relocatable block in question is locked.

`MoveHHI` is used to move relocatable blocks to the top of the heap. `HLockHI` is used to move relocatable blocks to the top of the heap and then lock them. Be aware, however, that `MoveHHI` and `HLockHI` cannot move a block to the top of the heap if a nonrelocatable block or locked relocatable block is located between its current location and the top of the heap. In this situation, the block will be moved to a location immediately below the nonrelocatable block or locked relocatable block.

## Purging and Reallocating Relocatable Blocks

In addition to compacting the heap in order to satisfy a memory allocation request, the Memory Manager may **purge** unlocked relocatable memory blocks that have been made purgeable.

`HPurge` and `HNoPurge` change a relocatable block from unpurgeable to purgeable and vice versa. When you make a relocatable block purgeable, your program should subsequently check the handle to that block before using it if calls are made to functions which could move or purge memory.

If the handle's master pointer is set to `NULL`, then the Operating System has purged its block. To use the information formerly in the block, space must then be reallocated for it and its contents must be reconstructed.

## Effect of a Relocatable Block's Attributes

Two **attributes** of a relocatable block are whether the block is currently locked/unlocked or purgeable/non-purgeable. These attributes are stored in bits in the block's master pointer **tag byte**. The following summarizes the effect of these attributes on the Memory Manager's ability to move and/or purge a relocatable block:

<i>Tag Byte Indicates Block Is</i>		<i>The Memory Manager Can</i>	
<i>Locked</i>	<i>Purgeable</i>	<i>Move The Block</i>	<i>Purge the Block</i>
NO	NO	<b>YES</b>	NO
NO	<b>YES</b>	<b>YES</b>	<b>YES</b>
<b>YES</b>	NO	NO	NO
<b>YES</b>	<b>YES</b>	NO	NO

**NOTE**

The tag byte is the high byte of a master pointer. If Bit 5 of the tag byte is set, the block is a resource block. If Bit 6 is set, the block is purgeable. If Bit 7 is set, the block is locked.

Note that a relocatable block created by a call to `NewHandle` is created initially unlocked and unpurgeable, and that locking a relocatable block will also make it unpurgeable if it is currently purgeable.

## Avoiding Heap Fragmentation

The ideal heap is one with all nonrelocatable blocks at the bottom of the heap, all unlocked relocatable blocks above that, free space above that, and all relocatable blocks which must be locked for significant periods at the top of the heap. This ideal can be approached, and significant heap fragmentation avoided, by adherence to the following rules:

- At the beginning of the program, call `MoreMasterPointers` to allocate at least as many (nonrelocatable) master pointers as are required during program execution.
- Allocate all other required nonrelocatable blocks at the beginning of the application's execution.
- Avoid disposing of, and subsequently reallocating, nonrelocatable blocks during the application's execution.
- If you need to allocate a relocatable block that will need to be locked for a long period of time, call `ReserveMem` at the beginning of the program to reserve memory for the block as close to the bottom of the heap as is possible, and then lock the block immediately after allocating it.
- If a relocatable block is to be locked for a short period of time and nonrelocatable blocks are to be allocated while it is locked, call `MoveHHI` to move the relocatable block to the top of the heap and then lock it. Unlock the block when it no longer needs to be locked.

Also bear in mind that, in memory management terms, a relocatable block that is always locked is worse than a nonrelocatable block in that nonrelocatable blocks are always allocated as low in the heap as possible, whereas a relocatable block is allocated wherever the Memory Manager finds it convenient.

## Master Pointer Tag Byte—HGetState and HSetState

There are certain circumstances where you will want to save, and later restore, the current value of a relocatable block's master pointer tag byte. Consider the following example, which involves three of an imaginary application's functions, namely, Function A, Function B, and Function C:

- Function A creates a relocatable block. For reasons of its own, Function A locks the block before executing a few lines of code. Function A then calls Function C, passing the handle to that function as a formal parameter.
- Function B also calls Function C at some point, passing the relocatable block's handle to it as a formal parameter. The difference in this instance is that, due to certain machinations in other areas of the application, the block is unlocked when the call to Function C is made.
- Function C, for reasons of its own, needs to ensure that the block is locked before executing a few lines of code, so it makes a call to HLock. Those lines executed, Function C then unlocks the block before returning to the calling function. This will not be of great concern if the return is to Function B, which expects the block to be still unlocked. However, if the return is to Function A, and if Function A now executes some lines of code which assume that the block is still locked, disaster could strike.

This is where the Memory Manager functions HGetState and HSetState come in. The sequence of events in Function C should have been as follows:

```
SInt8 theTagByte;
...
theTagByte = HGetState(myHandle); // Whatever the current state is, save it.
HLock(myHandle);                 // Redundant if Function A is calling, but no harm.

(Bulk of the Function C code, which requires handle to be locked.)

HSetState(myHandle,theTagByte)    // Leave it the way it was found. (It could have
                                // been locked. It could have been unlocked.)
return;
```

This is an example of what might be called a “well-mannered function”. It is an example of a rule that you may wish to apply whenever you write a function that takes a handle to a relocatable block as a formal parameter: If that function calls HLock, make sure that it leaves the block's tag byte (and thus the locked/unlocked bit) in the condition in which it found it.

**NOTE**

Of course, this save/restore precaution will not really be necessary if you are absolutely certain that the block in question will be in a particular state (locked or unlocked) every time Function C is called. But there is nothing wrong with a little coding overkill to protect yourself from, for example, some future source code modifications which may add other functions which call Function C, and which may assume that the block's attributes will be handed back in the condition in which Function C found them.

## Memory Leaks

When you have no further use for a block of memory, you ordinarily return that memory to the Memory Manager by calling `DisposePtr` or `DisposeHandle` (or `ReleaseResource`). In certain circumstances, not disposing of a block that is no longer required can result in what is known as a **memory leak**.

Memory leaks can have unfortunate consequences for your application. For example, consider the following function:

```
void theFunction(void)
{
    Ptr    thePointer;
    OSErr  osError;

    thePointer = NewPtr(10000);
    if(MemError() == memFullErr)
        doErrorAlert(eOutOfMemory);

    // The nonrelocatable block is used for some temporary purpose here, but is not
    // disposed of before the function returns.
}
```

When `theFunction` returns, the 10,000-byte nonrelocatable block will still exist (even though, incidentally, the local variable which previously pointed to it will not). Thus a large nonrelocatable block for which you have no further use remains in memory (at what is now, incidentally, an unknown location). If `theFunction` is called several more times, a new nonrelocatable block will be created by each call and the size of the memory leak will grow, perhaps eventually causing `MemErr` to return `memFullErr`. In this way, memory leaks can bring your application to a standstill and might, in some circumstances, cause it to crash.

**NOTE**

The dynamic memory inspection tool ZoneRanger, which is included with Metrowerks CodeWarrior, can be used to check your application for memory leaks.

## Memory Manager Errors

The error code resulting from the last call to a Memory Manager function might be retrieved by calling the function `MemError`. Some of the error codes which may be returned by `MemError` are as follows:

<i>Value</i>	<i>Constant</i>	<i>Description</i>
0	<code>noErr</code>	No error occurred.
-108	<code>memFullErr</code>	No room in heap.
-109	<code>nilHandleErr</code>	Illegal operation on a NULL handle.
-117	<code>memLockedErr</code>	Trying to move a locked block ( <code>MoveHHi</code> ).

## Managing Memory—Mac OS X Considerations

### Preamble—Memory in Mac OS X

In Mac OS X, each application runs in its own address space, meaning that an application cannot reference memory locations outside its assigned address space.

Compared with Mac OS 8/9, Mac OS X uses an entirely different heap structure and allocation behavior.

Mac OS X uses a dynamic and highly efficient virtual memory system, which is always enabled. Carbon application must therefore assume that virtual memory is always on.

### Memory Management Considerations

#### Allocating Memory

The functions `FreeMem` (get the amount of free memory in the current heap zone), `PurgeMem` (purge blocks without compacting the heap), and `MaxMem` (compact the heap and purge all the purgeable blocks from the current heap zone) are all included in Carbon, and behave as expected under Mac OS 8/9. When your application is running on Mac OS X, however, these functions are more or less meaningless because, in Mac OS X, the system provides virtually unlimited memory.



## Stack Size

A Carbon application may have different stack sizes under Mac OS 8/9 and Mac OS X; accordingly, the `StackSpace` function (which returns the amount of unused space on the stack at the time of the call) is no longer very useful.

## Master Pointer Allocation

Master pointers do not need to be pre-allocated, or their number optimized, in the Mac OS X memory model. Accordingly, the effect of the `MoreMasterPointers` function only applies when your application is run on Mac OS 8/9.

## Resources

In order to meet various requirements of the system software, your application must provide its own **resources**, for example, resources which describe the application's user interface elements such as menus, windows, controls, dialogs, and icons. In addition, the system software itself provides a number of resources (for example, fonts, patterns, icons, and so on) that may be used by your application.

The concept of resources reflects the fact that, in the Macintosh environment, intermixing code and data in a program is not encouraged. For example, it is usual practice to separate changeable data, such as message strings which may need to be changed in a foreign-language version of the application, from the application's code. All that is required in such a case is to create a resource containing the foreign language version of the message strings. There is thus no necessity to change and recompile the source code in order to produce a foreign-language version of the application.

The subject of resources is closely related to the subject of files. A brief digression into the world of files is thus necessary.

## About Files—The Data Fork and the Resource Fork

On the Macintosh, a **file** is a named, ordered sequence of bytes stored on a volume and divided into two forks:

- **The Data Fork.** The data fork typically contains data created by the user.
- **The Resource Fork.** The resource fork of a file contains resources, which are collections of data of a defined structure and type.

**NOTE**

Before the introduction of Mac OS X and Carbon, application and document resources were invariably stored in the resource fork of, respectively, application and document files. Mac OS X and Carbon introduced an alternative scheme whereby resources can be placed in the data fork of a separate resource file. The main reason for this alternative scheme is that it prevents application and document files from losing resource data when moved around different file systems or between Macintosh and non-Macintosh systems.

This alternative scheme is, however, not addressed in this book. The content of this book assumes that application and document resources are stored in the resource fork of application and document files, and the associated demonstration program files reflect that arrangement.

All Macintosh files contain both a resource fork and a data fork, even though one or both of these forks may be empty. Note that the resource fork of a file is also called a **resource file**, because in some respects you can treat it as if it were a separate file.

The resource fork of a document file contains resources specific to the document, such as the size and location of the document's window when the document was last closed. The resource fork of an application file includes, typically, resources that describe the application's windows, menus, and so on. Fig 4 illustrates the typical contents of the data and resource forks of an application file and a document file.

The data fork can contain any kind of data organized in any fashion. Your application can store data in the data fork of a document file in whatever way it deems appropriate, but it needs to keep track of the exact byte location of each particular piece of saved data in order to be able to access that data when required. The resource fork, on the other hand, is highly structured. As will be seen, all resource forks contain a map which, amongst other things, lists the location of all resources in the resource fork. This greatly simplifies the task of accessing those resources.

## Resources and the Application

During its execution, an application might read resources from

- The application's resource file, which is opened automatically when the application is launched.
- The System file, which is opened by the Operating System at startup and which contains resources that are shared by all applications (for example, fonts, icons, sounds, and so on) and resources that applications might use to help present the standard user interface.

- Other resource files, such as a preferences file in the Preferences folder holding the user's application-specific preferences, or the resource fork of a document file, which might define certain document-specific preferences.

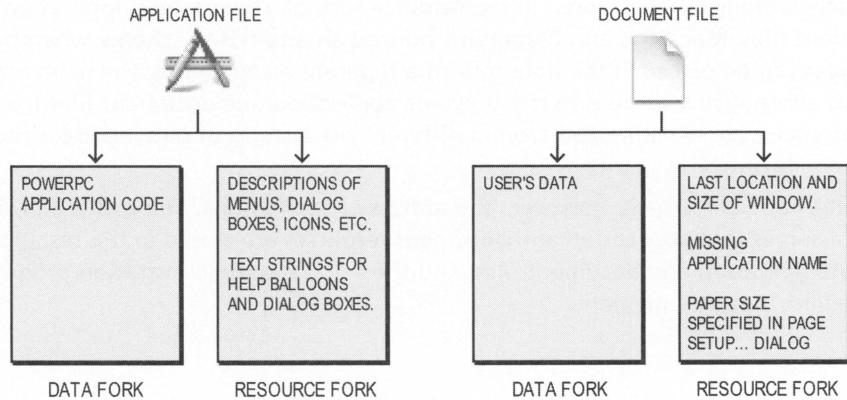


FIG 4 - TYPICAL CONTENTS OF DATA FORKS AND RESOURCE FORKS IN APPLICATION AND DOCUMENT FILES

The Resource Manager provides functions which allow your application to read in these resources and, in addition, to create, delete, open, modify and write resources in, from and to any Macintosh file. The following, however, is concerned only with creating resources for the application's resource file and with reading in **standard resources** from the application and System files. Other aspects of resources, including **custom resources** and resources in files other than the application and System files, are addressed in Chapter 19.

## Resource Types and Resource IDs

An application refers to a resource by passing the Resource Manager a **resource specification**, which consists of the **resource type** and a **resource ID**:

- **Resource Type.** A resource type is specified by any sequence of four alphanumeric characters, including the space character, which uniquely identifies a specific type of resource. Both uppercase and lowercase characters are used. Some of the standard resource types defined by the system software are as follows:

Type	Description	Type	Description
'ALRT'	Alert template.	'DLOG'	Dialog template.
'DITL'	Item list in dialog or alert.	'SIZE'	Size of application's partition and other info.
'FONT'	Bitmapped font.	'WIND'	Window template.
'MBAR'	Menu bar.	'snd '	Sound. (Space character is required.)
'PICT'	QuickDraw picture.	'STR#'	String list.

You can also create your own custom resource types if your application needs resources other than the standard types. An example would be a custom resource type for application-specific preferences stored in a preferences file.

## NOTE

When choosing the characters to identify your custom resource types, note that Apple reserves for its own use resource types consisting entirely of lowercase characters and special symbols. Your custom resource types should therefore contain at least one uppercase character.

- **Resource ID.** A resource ID identifies a specific resource of a given type by number. System resource IDs range from -32768 to 127. In general, resource IDs from 128 to 32767 are available for resources that you create yourself, although the numbers you can use for some types of resources (for example, font families) are more restricted. An application's definition functions should use IDs between 128 and 4095.

## Creating a Resource

At the very least, you may need to create resources for the standard user interface elements used by your application. You typically define the user interface elements in resources and then use Menu Manager, Window Manager, Dialog Manager or Control Manager functions to create these elements, based on their resource descriptions, as needed.

You can create resource descriptions using a resource editor such as Resorcerer (which uses the familiar point-and-click approach), or you can provide a textual, formal description of resources in a file and then use a resource compiler, such as Rez, to compile the description into a resource. An example of a resource definition for a window in Rez input format is as follows:

```
resource 'WIND' (128, preload, purgeable)
{
    {64,60,314,460},           /* Window rectangle. (Initial window size and location.) */
    kWindowDocumentProc,      /* Window definition ID. */
    invisible,                 /* Window is initially invisible. */
    goAway,                   /* Window has a close box. */
    0x0,                      /* Reference constant. */
    "untitled",               /* Window title. */
    staggerParentWindowScreen /* Optional positioning specification. */
};
```

The structure of the compiled 'WIND' resource is shown at Fig 5.

### NOTE

This book assumes the use of Resorcerer, and all demonstration program resources were created using Resorcerer.

	BYTES
INITIAL RECTANGLE	8
WINDOW DEFINITION ID	2
VISIBILITY STATUS	2
PRESENCE OF CLOSE BOX	2
REFERENCE CONSTANT	4
LENGTH (n) OF WINDOW TITLE	1
WINDOW TITLE	n
POSITIONING SPECIFICATION	2

**FIG 5 - STRUCTURE OF A COMPILED WINDOW ('WIND') RESOURCE**

### Resource Attributes

Note the words `preload` and `purgeable` in the preceding 'WIND' resource definition. These are constants representing **resource attributes**, which are flags which tell the Resource Manager how to handle the resource. Resource attributes are described by bits in the low-order byte of an integer value:

<i>Bit</i>	<i>Constant</i>	<i>Description</i>
1	<code>resChanged</code>	Resource has been changed.
2	<code>resPreload</code>	Resource is to be read into memory immediately after the resource fork is opened.
3	<code>resProtected</code>	Application cannot change the resource ID, modify the resource's contents or remove the resource from the resource fork.



<i>Bit</i>	<i>Constant</i>	<i>Description</i>
4	resLocked	Relocatable block occupied by the resource is to be locked. (Overrides the resPurgeable attribute.)
5	resPurgeable	Relocatable block occupied by the resource is to be purgeable.

Note that, if both the `resPreload` and the `resLocked` attributes are set, the Resource Manager loads the resource as low as possible in the heap.

**Resources Which Must Be Unpurgeable.** Some resources must *not* be made purgeable. For example, the Menu Manager expects menu resources to remain in memory at all times.

**Resources Which May Be Purgeable.** Other resources, such as those relating to windows, controls, and dialogs, do not have to remain in memory once the corresponding user interface element has been created. You may therefore set the purgeable attribute for those kinds of resources if you so desire. The following considerations apply to the decision as to whether to make a resource purgeable or unpurgeable:

- The concept of purgeable resources dates back to the time when RAM was limited and programmers had to be very careful about allowing resources which were not in use to continue to occupy precious memory. Nowadays, however, RAM is not so limited.
- Some resources (for example, large 'PICT' resources and 'snd ' resources) do require a lot of memory, even by today's standards. Accordingly, such resources should generally be made purgeable.
- As will be seen, there are certain hazards associated with the use of purgeable resources. These hazards must be negated by careful programming involving additional lines of code.

Given these considerations, a sound policy would be to make all small and basic resources unpurgeable and set the `resPurgeable` attribute only in the case of comparatively large resources which are not required to remain permanently in memory.

## Template Resources and Definition Resources

The 'WIND' resource defined above is an example of a **template resource**. A template resource defines the characteristics of a desktop object, in this case a window's size, location, and so on, and the **window definition function** (specified by the constant `kWindowDocumentProc`) to be used to draw it. Definition functions, which determine the look and behavior of a desktop object, are executable code segments contained within another kind of resource called a **definition resource**.

## Resources in Action

### The Resource Map

Your application file's resource fork contains, in addition to the resources you have created for your application, an automatically created **resource map**. The resource map contains entries for each resource in the resource fork.

When your application is launched, the system first gets the Memory Manager to create the application heap and allocate a block of master pointers at the bottom of the heap. The Resource Manager then opens your application file's resource fork and reads in the resource map, followed by those resources which have the `resPreload` attribute set.

The handles to the resources which have been loaded are stored in the resource map in memory. The following is a diagrammatic representation of a simple resource map in memory immediately after the resource map, together with those resources with the preload attribute set, have been loaded.

<i>Type</i>	<i>ID</i>	<i>Attributes</i>			<i>Handle</i>
MENU	128	<b>Preload</b>	<b>Lock</b>	<b>Purgeable</b>	123C
WIND	128	•		•	NULL
PICT	128			•	NULL
PICT	129			•	NULL

Note that the handle entry in the resource map contains NULL for those resources that have not yet been loaded. Note also that this handle entry is filled in only when a resource is loaded for the first time, and that that entry remains even if a purgeable resource is later purged by the Memory Manager.

### Reading in Non-Preloaded Resources

Some system software managers use the Resource Manager to read in resources for you. Using the 'WIND' resource listed in the above resource map as an example, when the Window Manager function `GetNewCWindow` is called to create a new window (specifying 128 as the resource ID), `GetNewCWindow`, in turn, calls the Resource Manager function `GetResource`. `GetResource` loads the resource (assuming that it is not currently in memory), returns the handle to `GetNewCWindow`, and copies the handle to the appropriate entry in the resource map. This is an example of an indirect call to the Resource Manager.

Other resources are read in by direct calls to the Resource Manager. For example, the 'PICT' resources listed in the above example resource map would be read in by calling another of the `Get...` family of resource-getting functions directly, for example:



```
#define rPicture1 128
#define rPicture2 129
...
PicHandle pic1Hdl;
PicHandle pic2Hdl;
...
pic1Hdl = GetPicture(rPicture1);
pic2Hdl = GetPicture(rPicture2);
```

Once again, and assuming that the resources have not previously been loaded, the handle returned by each `GetPicture` call is copied to the appropriate entry in the resource map.

## Purgeable Resources

When a resource that has the `resPurgeable` attribute set has been loaded for the first time, the handle to that resource is copied to the appropriate entry in the resource map in the normal way. If the Memory Manager later purges the resource, the master pointer pointing to that resource is set to `NULL` by the Memory Manager but the handle entry in the resource map remains. This creates what is known as an **empty handle**.

If the application subsequently calls up the resource, the Resource Manager first checks the resource map handle entry to determine whether the resource has ever been loaded (and thus whether a master pointer exists for the resource). If the resource map indicates that the resource has never been loaded, the Resource Manager loads the resource, returns its handle to the calling function, and copies the handle to the resource map.

If, on the other hand, the resource map indicates that the resource has previously been loaded (that is, the handle entry in the resource map contains the address of a master pointer), the Resource Manager checks the master pointer. If the master pointer contains `NULL`, the Resource Manager knows that the resource has been purged, so it reloads the resource and updates the master pointer. Having satisfied itself that the resource is in memory, the Resource Manager returns the resource's handle to the application.

## Problems with Purgeable Resources

Using purgeable resources optimises heap space; however, misuse of purgeable resources can crash an application. For example, consider the following code example, which loads two purgeable 'PICT' resources and then uses the drawing instructions contained in those resources to draw each picture.

```
pic1Hdl = GetPicture(rPicture1);    // Load first 'PICT' resource.
pic2Hdl = GetPicture(rPicture2);    // Load second 'PICT' resource.
if(pic1Hdl)                        // If the handle to first resource is not NULL ...
    DrawPicture(pic1Hdl,&destRect); // ... draw the first picture.
if(pic2Hdl)                        // If the handle to second resource is not NULL
    DrawPicture(pic2Hdl,&destRect); // ... draw the second picture.
```

GetPicture is one of the many functions that can cause memory to move. When memory is moved, the Memory Manager may purge memory to obtain more heap space. If heap space is extremely limited at the time of the second call to GetPicture, the first resource will be purged by the Memory Manager, which will set the master pointer to the first resource to NULL to reflect this condition. The variable pic1Hdl will now contain an empty handle. Passing an empty handle to DrawPicture just about guarantees a crash. (Of course, in the preceding code example, the possibility of a crash is avoided because the line `if(pic1Hdl)` prevents the line from executing.)

There is a second problem with this code. Like GetPicture, DrawPicture also has the potential to move memory blocks. If the second call to GetPicture did not result in the first resource being purged, the possibility remains that it will be purged while it is being used (that is, during the execution of the DrawPicture function).

To avoid such problems when using purgeable resources, you should observe these steps:

- Get (that is, load) the resource only when it is needed.
- Immediately make the resource un purgeable.
- Use the resource immediately after making it un purgeable.
- Immediately after using the resource, make it purgeable.

The following revised version of the code demonstrates this approach:

```
pic1Hdl = GetPicture(rPicture1);    // Load first 'PICT' resource.
if(pic1Hdl)                        // If the resource was successfully loaded ...
{
    HNoPurge((Handle) pic1Hdl);    // make the resource un purgeable ...
    DrawPicture(pic1Hdl,&destRect); // draw the first picture ...
    HPurge((Handle) pic1Hdl);      // and make the resource purgeable again.
}

pic2Hdl = GetResource(rPicture2);  // Repeat for the second 'PICT' resource.
if(pic2Hdl)
{
    HNoPurge((Handle) pic2Hdl );
    DrawPicture(pic2Hdl,&destRect);
    HPurge((Handle) pic2Hdl );
}
```

Note that this procedure only applies when you use functions that get resources directly (for example GetResource, GetPicture, and so on). It is not required when you call GetResource indirectly (for example, when you call the Window Manager function GetNewCWindow) because functions like GetNewCWindow know how to treat purgeable resources properly.

Note also that `LoadResource` may be used to ensure that a previously loaded, but purgeable, resource is in memory before an attempt is made to use it. If the specified resource is not in memory, `LoadResource` will load it. The essential difference between `LoadResource` and the `Get...` family of resource-getting functions is that the latter *return* a handle to the resource (loading the resource if necessary), whereas `LoadResource` *takes* a handle to a resource as a parameter and loads the resource if necessary.

## Releasing Resources

When you have finished using a resource loaded by a function which gets resources directly, you should call the appropriate function to release the memory associated with that resource. For example, `ReleaseResource` is used in the case of generic handles obtained with the `GetResource` function. `ReleaseResource` frees up all the memory occupied by the resource and sets the resource's handle in the resource map to `NULL`.

You do not need to be concerned with explicitly releasing resources loaded indirectly (for example, by a call to `GetNewCWindow`). Using the case of a window resource template as an example, the sequence of events following a call to `GetNewCWindow` is as follows:

- `GetNewCWindow` calls `GetResource` to read in the window resource template whose ID is specified in the `GetNewCWindow` call.
- A relocatable block is created for the template resource and marked as purgeable, as specified by the resource's attributes. (You should always specify window template resources as purgeable.)
- The window template's block is then temporarily marked as unpurgeable while
  - A block is created for an opaque data structure known as a window object.
  - Data is copied from the resource template into the window object.
- The window template's block is then marked as purgeable.

### NOTE

Opaque data structures are explained in Chapter 3.

## Resource Manager Errors

The error code resulting from the last call to a Resource Manager function may be retrieved by calling the function `ResError`. Some of the error codes which may be returned by `ResError` are as follows:

<i>Value</i>	<i>Constant</i>	<i>Description</i>
0	noErr	No error occurred.
-192	resNotFound	Resource not found.
-193	resFNotFound	Resource file not found.

## Main Memory Manager Data Types and Functions

### Data Types

```
typedef char *Ptr;      // Pointer to nonrelocatable block.
typedef Ptr *Handle;   // Handle to relocatable block.
typedef long Size;     // Size of a block in bytes.
```

### Function

#### Allocating and Releasing NonRelocatable Blocks of Memory

```
Ptr    NewPtr(Size byteCount);
Ptr    NewPtrClear(Size byteCount);
void   DisposePtr(Ptr p);
```

#### Allocating and Releasing Relocatable Blocks of Memory

```
Handle NewHandle(Size byteCount);
Handle NewHandleClear(Size byteCount);
Handle NewEmptyHandle(void);
Handle NewEmptyHandleSys(void);
void   DisposeHandle(Handle h);
```

#### Changing the Sizes of Nonrelocatable and Relocatable Blocks

```
Size   GetPtrSize(Ptr p);
void   SetPtrSize(Ptr p, Size newSize);
Size   GetHandleSize(Handle h);
void   SetHandleSize(Handle h, Size newSize);
```

#### Setting the Properties of Relocatable Blocks

```
void   HLock(Handle h);
void   HUnlock(Handle h);
void   HPurge(Handle h);
void   HNoPurge(Handle h);
SInt8  HGetState(Handle h);
void   HSetState(Handle h, SInt8 flags);
```

#### Managing Relocatable Blocks

```
void   EmptyHandle(Handle h);
void   ReallocateHandle(Handle h, Size byteCount);
Handle RecoverHandle(Ptr p);
void   ReserveMem(Size cbNeeded);
void   MoveHHi(Handle h);
void   HLockHi(Handle h);
```

## Manipulating Blocks of Memory

```

void    BlockMove(const void *srcPtr,void *destPtr,Size byteCount);
void    BlockMoveData(const void *srcPtr,void *destPtr,Size byteCount);
OSErr   PtrToHand(const void *srcPtr,Handle *dstHndl,long size);
OSErr   PtrToXHand(const void *srcPtr,Handle dstHndl,long size);
OSErr   HandToHand(Handle *theHndl);
OSErr   HandAndHand(Handle hand1,Handle hand2);
OSErr   PtrAndHand(const void *ptr1,Handle hand2,long size);

```

## Allocating Master Pointers

```

void    MoreMasterPointers(UInt32 inCount);

```

## Accessing Memory Conditions and Freeing Memory

```

long    FreeMem(void);           // Useful under Mac OS 8/9, almost meaningless under Mac OS X.
void    PurgeMem(Size cbNeeded); // Useful under Mac OS 8/9, almost meaningless under Mac OS X.
Size    MaxMem(size *grow);     // Useful under Mac OS 8/9, almost meaningless under Mac OS X.
long    MaxBlock(void);
void    PurgeSpace(long *total,long *contig);
long    StackSpace(void);       // Not very useful in Carbon.
Size    CompactMem(Size cbNeeded);

```

## Checking for Errors

```

OSErr   MemError(void);

```

# Main Resource Manager Constants, Data Types, and Functions

## Constants

### Resource Attributes

```

resSysHeap    = 64   System or application heap?
resPurgeable  = 32   Purgeable resource?
resLocked     = 16   Load it in locked?
resProtected  = 8     Protected?
resPreload    = 4     Load in on OpenResFile?
resChanged    = 2     Resource changed?

```

## Data Types

```

typedef unsigned long    FourCharCode;
typedef FourCharCode    ResType;

```

## Functions

### Reading Resources Into Memory

```

Handle    GetResource(ResType theType,short theID);
Handle    Get1Resource(ResType theType,short theID);
void      LoadResource(Handle theResource);

```

## Disposing of Resources

```
void    ReleaseResource(Handle theResource);
```

## Checking for Errors

```
short    ResError(void);
```

# Demonstration Program SysMemRes Listing

```
// *****
// SysMemRes.c
// *****
//
// This program:
//
// · Loads a window template ('WIND') resource and creates a window.
//
// · Allocates a relocatable block in the application's heap, gets its size in bytes, draws
//   the size in the window, and then disposes of the block.
//
// · Loads a purgeable 'PICT' resource and a non-purgeable 'STR ' resource and draws them in
//   the window.
//
// · Checks if any error codes were generated as a result of calls to Memory Manager and
//   Resource Manager functions.
//
// · Terminates when the mouse button is clicked.
//
// The program utilises the following resources:
//
// · A 'plst' resource.
//
// · A 'WIND' resource (purgeable).
//
// · A 'PICT' resource (purgeable).
//
// · A 'STR ' resource (non-purgeable).
//
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rWindowResourceID 128
#define rStringResourceID 128
#define rPictureResourceID 128
```



```
// ..... function prototypes

void main          (void);
void doPreliminaries (void);
void doNewWindow    (void);
void doMemory       (void);
void doResources     (void);

// ***** main

void main(void)
{
    doPreliminaries();
    doNewWindow();
    doMemory();
    doResources();

    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);

    while(!Button())
        ;
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(32);
    InitCursor();
}

// ***** doNewWindow

void doNewWindow(void)
{
    WindowRef windowRef;

    windowRef = GetNewCWindow(rWindowResourceID,NULL,(WindowRef) -1);
    if(windowRef == NULL)
    {
        SysBeep(10);
        ExitToShell();
    }

    SetPortWindowPort(windowRef);
    UseThemeFont(kThemeSystemFont,smSystemScript);
}
```

```
// ***** doMemory

void doMemory(void)
{
    Handle theHdl;
    Size    blockSize;
    OSErr   memoryError;
    Str255  theString;

    theHdl = NewHandle(1024);
    if(theHdl != NULL)
        blockSize = GetHandleSize(theHdl);

    memoryError = MemError();
    if(memoryError == noErr)
    {
        MoveTo(170,35);
        DrawString("\pBlock Size (Bytes) = ");
        NumToString(blockSize,theString);
        DrawString(theString);

        MoveTo(165,55);
        DrawString("\pNo Memory Manager errors");

        DisposeHandle(theHdl);
    }
}

// ***** doResources

void doResources(void)
{
    PicHandle  pictureHdl;
    StringHandle stringHdl;
    Rect       pictureRect;
    OSErr      resourceError;

    pictureHdl = GetPicture(rPictureResourceID);
    if(pictureHdl == NULL)
    {
        SysBeep(10);
        ExitToShell();
    }

    SetRect(&pictureRect,148,75,348,219);

    HNoPurge((Handle) pictureHdl);
    DrawPicture(pictureHdl,&pictureRect);
    HPurge((Handle) pictureHdl);

    stringHdl = GetString(rStringResourceID);
    if(stringHdl == NULL)
```

```

{
    SysBeep(10);
    ExitToShell();
}

MoveTo(103,250);
DrawString(*stringHdl);

ReleaseResource((Handle) pictureHdl);
ReleaseResource((Handle) stringHdl);

resourceError = ResError();
if(resourceError == noErr)
{
    MoveTo(160,270);
    DrawString("\pNo Resource Manager errors");
}
}

// *****

```

## Demonstration Program SysMemRes Comments

### The 'plst' (Property List) Resource

As stated in the listing, one of the resources utilized by the program is a 'plst' (property list) resource. Carbon applications must contain a 'plst' resource with ID 0 in order for the Mac OS X Launch Services Manager to recognize them as Carbon applications. If the 'plst' resource is not provided, the application will be launched as a Classic application.

The 'plst' resource used is actually an empty 'plst' resource. As will be seen at Chapter 9, however, this resource, apart from causing Mac OS X to recognize applications as Carbon applications, also allows applications to provide information about themselves to the Mac OS X Finder.

### includes

Carbon greatly simplifies the matter of determining which Universal Headers files need to be included in this section in any program. All that is required is to include the header file `Carbon.h`, which itself causes a great many header files to be included. For this particular program, if `Carbon.h` is not specified, the following header files would need to be included for the reasons indicated:

`Appearance.h`    **Constant:**    `kThemeSystemFont`

`Appearance.h` itself includes `MacTypes.h`, which contains:

**Data Types:**    `SInt16`   `Str255`   `Size`   `OSErr`   `Handle`   `Rect`   `StringHandle`  
**Constants:**    `noErr`   `NULL`

Appearance.h also includes MacWindows.h, which contains:

**Prototypes:** GetNewCWindow GetWindowPort

MacWindows.h itself includes Events.h, which contains:

**Prototype:** Button

MacWindows.h also includes Menus.h, which itself includes Processes.h, which contains:

**Prototype:** ExitToShell

Appearance.h also includes QuickDraw.h, which contains:

**Prototypes:** InitCursor SetPortWindowPort SetRect DrawPicture MoveTo  
GetPicture

**Data Types:** WindowRef PicHandle

QuickDraw.h itself includes QuickDrawText.h, which contains:

**Prototypes:** TextFont DrawString

MacMemory.h **Prototypes:** NewHandle DisposeHandle GetHandleSize HNoPurge HPurge  
MemError MoreMasterPointers

Resources.h **Prototypes:** ReleaseResource ResError

Sound.h **Prototype:** SysBeep

TextUtils.h **Prototype:** GetString

TextUtils.h itself includes NumberFormatting.h, which contains:

**Prototypes:** NumToString

It would be a good idea to peruse the header files MacMemory.h and Resources.h at this stage. Another header file which should be perused early in the piece is MacTypes.h.

## defines

Constants are established for the resource IDs of the 'WIND', 'PICT' and 'STR' resources.

## main

The main function calls the functions that perform certain preliminaries common to most applications, create a window, allocate and dispose of a relocatable memory block, and draw a picture and text in the window. It then waits for a button click before terminating the program

The call to the QuickDraw function QDFlushPortBuffer is ignored when the program is run on Mac OS 8/9. It is required on Mac OS X because Mac OS X windows are double-buffered. (The picture and text are drawn in a buffer and, in this program, the buffer has to be flushed to the screen by calling QDFlushPortBuffer.) This is explained in more detail in Chapter 4.

## doPreliminaries

The call to `MoreMasterPointers` is ignored when the program is run on Mac OS X. (Master pointers do not need to be pre-allocated, or their number optimized, in the Mac OS X memory model.)

On Mac OS 8/9, the call to `MoreMasterPointers` to allocate additional master pointers is really not required in this simple program because the system automatically allocates one block of master pointers at application launch. However, in larger applications where more than 64 master pointers are required, the call to `MoreMasterPointers` should be made here so that all master pointer (nonrelocatable) blocks are located at the bottom of the heap. This will assist in preventing heap fragmentation. Note that specifying a number less than 32 in the `inCount` parameter will result in 32 master pointers in the allocated block.

The call to `InitCursor` sets the cursor shape to the standard arrow cursor and sets the cursor level to 0, making it visible.

## doNewWindow

`doNewWindow` creates a window.

The call to `GetNewCWindow` creates a window using the 'WIND' template resource specified in the first parameter. The type, size, location, title, and visibility of the window are all established by the 'WIND' resource. The third parameter tells the Window Manager to open the window in front of all other windows.

Recall that, as soon as the data from the 'WIND' template resource is copied to the opaque data structure known as a window object during the creation of the window, the relocatable block occupied by the template will automatically be marked as purgeable.

The call to `SetPortWindowPort` makes the new window's graphics port the current port for drawing operations. The call to the Appearance Manager function `UseThemeFont` sets the font for that port to the system font.

## doMemory

`doMemory` allocates a relocatable block of memory, gets the size of that block and draws it in the window (or, more accurately, in the window's graphics port), and checks for memory errors.

The call to `NewHandle` allocates a relocatable block of 1024 bytes. The call to `GetHandleSize` returns the size of the allocated area available for data storage (1024 bytes). (The actual memory used by a relocatable block includes a block header and up to 12 bytes of filler.)

The call to `MemError` returns the error code of the most recent call to the Memory Manager. If no error occurred, the size returned by `GetHandleSize` is drawn in the window, together with a message to the effect that `MemError` returned no error. `DisposeHandle` is then called to free up the memory occupied by the relocatable block.

`MoveTo` moves a “graphics pen” to the specified horizontal and vertical coordinates. `DrawString` draws the specified string at that location. `NumToString` creates a string of decimal digits representing the value of a 32-bit signed integer. These calls are incidental to the demonstration.

### **doResources**

`doResources` draws a picture and some text strings in the window.

`GetPicture` reads in the 'PICT' resource corresponding to the ID specified in the `GetPicture` call. If the call is not successful, the system alert sound is played and the program terminates.

The `SetRect` call assigns values to the left, top, right and bottom fields of a `Rect` variable. This `Rect` is required for a later call to `DrawPicture`.

The basic rules applying to the use of purgeable resources are to load it, immediately make it unpurgeable, use it immediately, and immediately make it purgeable. Accordingly, the `HNoPurge` call makes the relocatable block occupied by the resource unpurgeable, the `DrawPicture` call draws the picture in the window's graphics port, and the `HPurge` call makes the relocatable block purgeable again. Note that, because `HNoPurge` and `HPurge` expect a parameter of type `Handle`, `pictureHdl` (a variable of type `PicHandle`) must be cast to a variable of type `Handle`.

`GetString` then reads in the specified 'STR' resource. Once again, if the call is not successful, the system alert sound is played and the program terminates. `MoveTo` moves the graphics “pen” to an appropriate position before `DrawString` draws the string in the window's graphics port. (Since the 'STR' resource, unlike the 'PICT' resource, does not have the purgeable bit set, there is no requirement to take the precaution of a call to `HNoPurge` in this case.)

Note the parameter in the call to `DrawString`. `stringHdl`, like any handle, is a pointer to a pointer. It contains the address of a master pointer which, in turn, contains the address of the data. Dereferencing the handle once, therefore, gets the required parameter for `DrawString`, which is a pointer to a string.

The calls to `ReleaseResource` release the 'PICT' and 'STR' resources. These calls release the memory occupied by the resources and set the associated handles in the resource map in memory to `NULL`.

The `ResError` call returns the error code of the most recent resource-related operation. If the call returns `noErr` (indicating that no error occurred as a result of the most recent call by a Resource Manager function), some advisory text is drawn in the window.

The next six lines examine the result of the most recent call to a memory manager function and draw some advisory text if no error occurred as a result of that call.



Note that the last two calls to `DrawString` utilize “hard-coded” strings. This sort of thing is discouraged in the Macintosh programming environment. Such strings should ordinarily be stored in a ‘STR#’ (string list) resource rather than hard-coded into the source code. The `\p` token causes the compiler to compile these strings as Pascal strings.

## PASCAL STRINGS AND C STRINGS

As stated in the Preface, when it comes to the system software, the ghost of the Pascal language forever haunts the C programmer. For example, a great many system software functions take Pascal strings as a required parameter, and some functions return Pascal strings.

Pascal and C strings differ in their formats. A C string comprises the characters followed by a terminating `\0` (or NULL byte):

```
+---+---+---+---+---+---+---+---+
| M | Y |   | S | T | R | I | N | G | \0 |
+---+---+---+---+---+---+---+---+
```

A C string is thus said to be “null-terminated”.

In a Pascal string, the first byte contains the length of the string, and the characters follow that byte:

```
+---+---+---+---+---+---+---+---+
| 9 | M | Y |   | S | T | R | I | N | G |
+---+---+---+---+---+---+---+---+
```

Not surprisingly, then, Pascal strings are often referred to as “length-prefixed” strings.

In the demonstration program, you encountered the data type `Str255`. `Str255` is the C name for a Pascal-style string capable of holding up to 255 characters. As you would expect, the first byte of a `Str255` holds the length of the string and the following bytes hold the characters of the string.

Utilizing 256 bytes for a string will simply waste memory in many cases. Accordingly, the header file `MacTypes.h` defines the additional types `Str63`, `Str32`, `Str31`, `Str27`, and `Str15`, as well as the `Str255` type:

```
typedef unsigned char Str255[256];
typedef unsigned char Str63[64];
typedef unsigned char Str32[33];
typedef unsigned char Str31[32];
typedef unsigned char Str27[28];
typedef unsigned char Str15[16];
```

Note, then, that a variable of type `Str255` holds the address of an array of 256 elements, each element being one byte long.

As an aside, in some cases you may want to use C strings, and use standard C library functions such as `strlen`, `strcpy`, etc., to manipulate them. Accordingly, be aware that

functions exist (CopyPascalStringToC, CopyCStringToPascal) to convert a string from one format to the other.

You may wish to make a “working” copy of the SysMemRes demonstration program file package and, using the working copy of the source code file SysMemRes.c, replace the function doResources with the following, compile-link-run, and note the way the second and third strings appear in the window.

```
void doResources(void)
{
    Str255 string1 = "\pIs this a Pascal string I see before me?";
    Str255 string2 = "Is this a Pascal string I see before me?";
    Str255 string3 = "%s this a Pascal string I see before me?";
    Str255 string4;
    SInt16 a;

    // Draw string1

    MoveTo(30,100);
    DrawString(string1);

    // Change the length byte of string1 and redraw

    string1[0] = (char) 23;
    MoveTo(30,120);
    DrawString(string1);

    // Leave the \p token out at your peril
    // I (ASCII code 73) is now interpreted as the length byte

    MoveTo(30,140);
    DrawString(string2);

    // More peril:- % (ASCII code 37) is now the length byte

    MoveTo(30,160);
    DrawString(string3);

    // A hand-built Pascal string

    for(a=1;a<27;a++)
        string4[a] = (char) a + 64;

    string4[0] = (char) 26;

    MoveTo(30,180);
    DrawString(string4);

    // But is there a Mac OS function to draw the C strings correctly?

    MoveTo(30,200);
    DrawText(string2,0,40); // Look it up in your reference
}
```

## MORE ON STRINGS—UNICODE AND CFString OBJECTS

In the Carbon era, no discussion of strings would be complete without reference to Unicode and CFString objects.

### *Preamble—Writing Systems, Character Encoding and Character Sets,*

A writing system (for example, Roman, Hebrew, Arabic) comprises a set of characters and the basic rules for using those characters in creating a visual depiction of a language. An individual character is a symbolic representation of an element of a writing system.

In memory, an individual character is stored as a character code, a numeric value that defines that particular character. One byte (8 bits) is commonly used to store a single character code, which allows for a character set of 256 characters maximum.

A total of 256 numeric values is, of course, quite inadequate to provide for all the characters in all the world's writing systems, meaning that different character sets must be used for different writing systems. In one-byte encoding systems, therefore, these different character sets are said to "overlap."

As an aside, the Apple Standard Roman character set (an extended version of the 128-character ASCII character set) is the fundamental character set for the Macintosh computer. To view the printable characters in this set, replace the main function in the SysMemRes demonstration program with the following:

```
void main(void)
{
    WindowRef windowRef;
    SInt16    fontNum, a,b;
    UInt8     characterCode = 0;

    doPreliminaries();
    windowRef = GetNewCWindow(rWindowResourceID,NULL,(WindowPtr) -1);
    SetPortWindowPort(windowRef);

    GetFNum("\pGeneva",&fontNum);
    TextFont(fontNum);

    for(a = 0;a < 256;a += 16)
    {
        for(b=0;b<16;b++)
        {
            MoveTo((a * 1.5) + 60,(b * 15) + 40);
            DrawText(&characterCode,0,1);
            characterCode++;
        }
    }

    while(!Button())
    ;
}
```



In addition to the overlapping of character sets between writing systems, a further problem is conflicting character encodings within a single writing system. For an example of this in the Roman writing system, change "`\pGeneva`" to "`\pSymbol`" in the above substitute main function.

### **Unicode**

Unicode is an international standard that combines all the characters for all commonly used writing systems into a single character set. It uses 16 bits per character, allowing for a character set of up to 65,535 characters. With Unicode, therefore, the character sets of separate writing systems do not overlap. In addition, Unicode eliminates the problem of conflicting character encodings within a single writing system, such as that between the Roman character codes and the codes of the symbols in the Symbol font.

Unicode makes it possible to develop and localize a single version of an application for users who speak most of the world's written languages, including Russian (Cyrillic), Arabic, Chinese, and Japanese.

### **Core Foundation's String Services**

Core Foundation is a component of the system software. Through its String Services, Core Foundation facilitates easy and consistent internationalization of applications. The essential part of this support is an opaque data type (`CFString`). A `CFString` "object" represents a string as an array of 16-bit Unicode characters. Several Appearance Manager, Control Manager, Dialog Manager, Window Manager, Menu Manager, and Carbon Printing Manager functions utilize `CFStrings`.

`CFString` objects come in immutable and mutable variants. Mutable strings may be manipulated by appending string data to them, inserting and deleting characters, and padding and trimming characters.

`CFStrings` have many associated functions that do expected things with strings such as comparing, inserting, and appending. Functions are also available to convert Unicode strings (that is, `CFStrings`) to and from other encodings, particularly 8-bit encodings (such as the Apple Standard Roman character encoding) stored as Pascal and C strings.

### **Example**

For a basic example of the use of `CFStrings`, remove the calls to `doMemory` and `doResources`, and the functions themselves, from the main function in the original version of the demonstration program `SysMemRes` and replace the function `doNewWindow` with the following:

```
void doNewWindow(void)
{
    WindowRef    windowRef;
    Str255        pascalString = "\pThis window title was set using a CFString object";
```

```

CFStringRef titleStringRef;
CFStringRef textStringRef = CFSTR("A CFString object converted to a Str255");
Boolean      result;
Str255       textString;

windowRef = GetNewCWindow(rWindowResourceID, NULL, (WindowPtr) -1);
SetPortWindowPort(windowRef);
UseThemeFont(kThemeSystemFont, smSystemScript);

titleStringRef = CFStringCreateWithPascalString(NULL, pascalString,
                                                CFStringGetSystemEncoding());
SetWindowTitleWithCFString(windowRef, titleStringRef);

result = CFStringGetPascalString(textStringRef, textString, 256,
                                CFStringGetSystemEncoding());

if(result)
{
    MoveTo(135, 130);
    DrawString(textString);
}

if(titleStringRef != NULL)
    CFRelease(titleStringRef);
}

```

At the sixth line, an immutable CFString object is created. The easiest way to do this is to use the CFSTR macro. The argument of the macro must be a constant compile-time string (that is, text enclosed in quotation marks) that contains only ASCII characters. CFSTR returns a reference (textStringRef) to a CFString object. This will be used later.

The call to the String Services function CFStringCreateWithPascalString converts a Pascal string (pascalString, of type Str255) to a CFString object. The reference to the CFString object is then passed in a call to the Window Manager function SetWindowTitleWithCFString to set the window's title.

The call to the String Services function CFStringGetPascalString converts the CFString object (textStringRef) previously created by the CFSTR macro to a Pascal string (textString, of type Str255). 256, rather than 255, is passed in the bufferSize parameter to accommodate the length byte. textString is then passed in a call to the QuickDraw function DrawString, which draws the string in the window.

The golden rules for releasing CFString objects are if a "Create" or "Copy" function is used, CFString should be called to release the string when no longer required; if a "Get" function is used, CFString should not be called. Accordingly, CFRelease is called only in the case of titleStringRef. Note that CFRelease is not NULL-safe, so you must check for a non-NULL value before passing something to CFRelease.





# The Classic Event Manager— Low-Level and Operating System Events

## CHAPTER

# 2

## IN THIS CHAPTER

- The Two Event Managers 42
- Overview of the Classic Event Model 42
- Obtaining Information About Events 46
- Flushing the Operating System Event Queue 52
- Handling Events 52
- Handling Events in Alerts and Dialogs 61
- The 'SIZE' Resource 62
- Main Event Manager Constants, Data Types and Functions 65
- Demonstration Program LowEvents Listing 67
- Demonstration Program LowEvents Comments 72

## The Two Event Managers

As stated in Chapter 1, there are two managers in the system software's Human Interface Group that pertain to the subject of events. These two managers are:

- The Event Manager (often unofficially referred to, in the Carbon era, as the Classic Event Manager).
- The somewhat more sophisticated Carbon Event Manager, which was introduced with Carbon.

Carbon applications may utilise either of these two event models. This chapter addresses the Classic event model. The Carbon event model is addressed in Chapter 17.

## Overview of the Classic Event Model

### The Main Event Loop

Any Macintosh application displays one essential characteristic: It is event-driven. At its most basic level, the application's general strategy is to retrieve an **event** (such as a key press or a mouse click), process it, retrieve the next event, process it, and so on indefinitely until the user quits the application. The core of the application is thus the **main event loop** (see Fig 1).

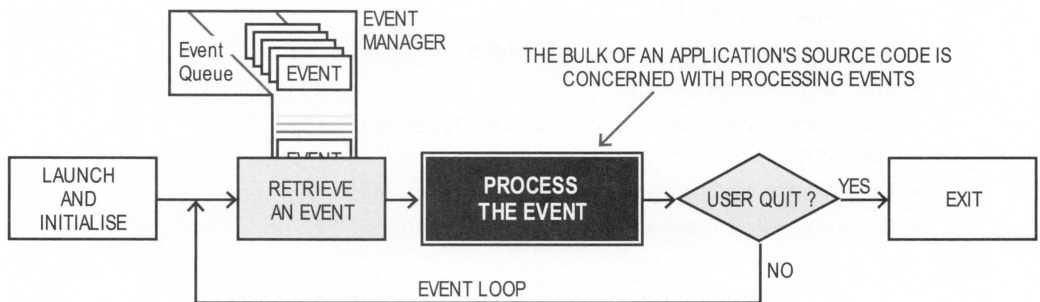


FIG 1 - THE MAIN EVENT LOOP

If no events are pending for the active application at a particular time, that application can choose to relinquish control of the CPU (central processing unit, or microprocessor) for a specified amount of time before again checking to see whether an event has occurred. Events are retrieved, and processor time is relinquished, using the `WaitNextEvent` function. The `WaitNextEvent` function is, in a sense, the core of the Classic event model.

Information about a received event is placed in an **event structure**. An application may specify which types of events it wants to receive by including an **event mask** as a parameter in certain Event Manager functions.

## Categories of Events

An application can receive many types of events. It can also send certain types of events to other applications. Events are broadly categorized as **low-level** events, **Operating System** events, and **high-level** events. The high-level event is the category of event used to send events to other applications.

Of the three categories, this chapter is concerned only with low-level events and Operating System events. High-level events are addressed in Chapter 10.

### Low-Level Events

Low-level events, which are sent to the application by the Toolbox Event Manager, are originated by such low-level occurrences as pressing and releasing a key and pressing and releasing the mouse button.

The Window Manager also originates low-level events, specifically, two events relating to an application's windows:

- The **activate** event, which has to do with informing the application to make changes to the appearance of a window depending on whether or not it is the frontmost window.
- The **update** event, which has to do with informing the application to redraw a window's contents.

The event that reports that the Event Manager has no other events to report (the **null** event) is also categorized as a low-level event.

Low-level events, except for update events and null events, are invariably directed to the foreground process only.

### Operating System Events

Operating System events are returned to the application when the operating status of an application changes. For example, when an application has been switched to the background, the Process Manager sends it a **suspend** event. Then, when the application is switched back to the foreground, the Process Manager sends it a **resume** event.

Another Operating System event, called the **mouse-moved** event, is sent when the mouse pointer is moved outside a designated region.

## Processes and Events

The subject of **processes** is of some relevance to the subject of events, more particularly to operating system events.

Ordinarily, a user will have more than one application running at the one time. The active application (the application with which the user is currently interacting) is known as the **foreground process**. The remaining open applications, if any, are known as **background processes**. The user can bring a background process to the foreground by, for example, clicking in one of its windows. When an application is switched between background and foreground in this way, a **major switch** is said to have occurred.

The foreground process has first priority for accessing the CPU, background processes accessing the CPU only when the foreground process yields time to them. Any application whose 'SIZE' resource specifies that it should receive null events when it is in the background is eligible for CPU time when it is not in the foreground. A **minor switch** is said to have occurred when a background process gains a period of CPU access without being brought to the foreground.

## Low-Level and Operating System Events, System Software, and Applications

Fig 2 shows the relationship between low-level and Operating System events, system software managers and open applications.

In Fig 2, note that, in addition to the Operating System event queue created by the Operating System Event Manager, the Toolbox Event Manager maintains a separate event stream for each open application. An event stream contains only those events which are available to the related application. Also note that, when an application is in the background, its event stream can contain only update events, null events, and suspend events, the latter two only if the application's 'SIZE' resource so specifies.

### NOTE

An application in the background can also receive high-level events. (See Chapter 10.)

A maximum of 48 events can be pending in the Operating System event queue. If the queue becomes full, the oldest event is discarded to make room for the new.

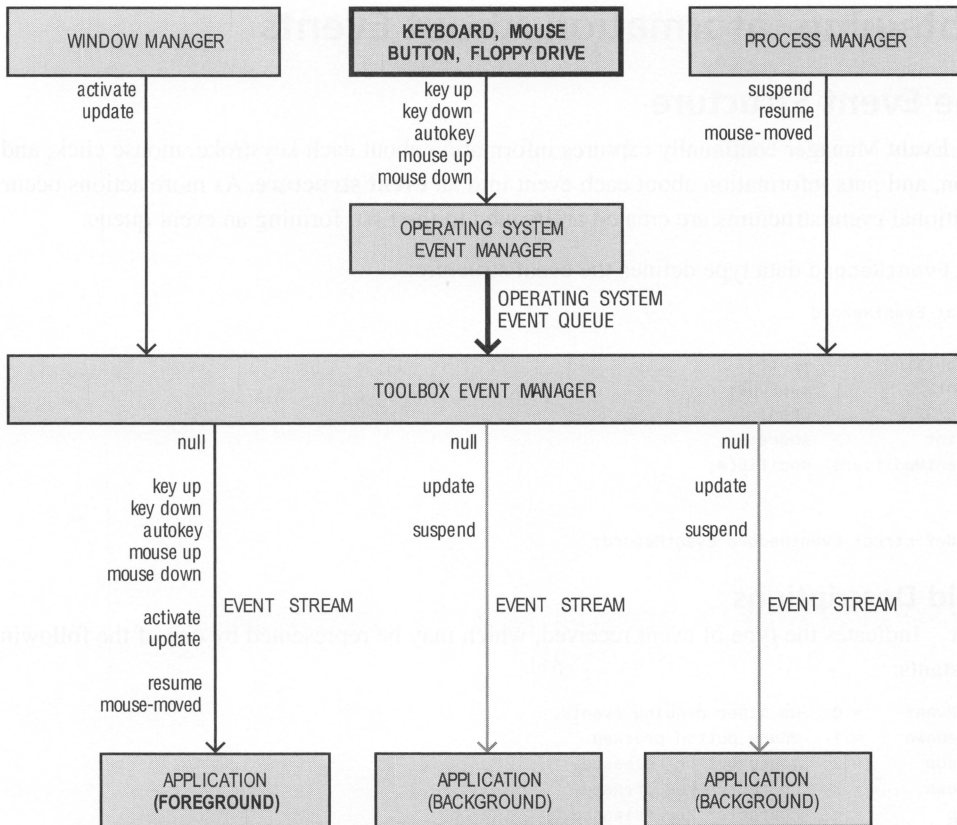


FIG 2 - LOW-LEVEL AND OPERATING SYSTEM EVENTS

## Priority of Events

In general, the Event Manager returns events to the application in the order low-level events, Operating System events, and high-level events. In detail, the order of priority is:

- Activate events
- Mouse-down, mouse-up, key-down, and key-up events in FIFO (first in, first out) order.
- Auto-key events
- Update events, in front-to-back order of windows
- Operating system events
- High-level events
- Null events



## Obtaining Information About Events

### The Event Structure

The Event Manager continually captures information about each keystroke, mouse click, and so on, and puts information about each event into an **event structure**. As more actions occur, additional event structures are created and joined to the first, forming an event queue.

The EventRecord data type defines the event structure:

```
struct EventRecord
{
    EventKind      what;
    UInt32         message;
    UInt32         when;
    Point          where;
    EventModifiers  modifiers;
};

typedef struct EventRecord EventRecord;
```

### Field Descriptions

**what** Indicates the type of event received, which may be represented by one of the following constants:

```
nullEvent      = 0   No other pending events.
mouseDown      = 1   Mouse button pressed.
mouseUp        = 2   Mouse button released.
keyDown        = 3   Character key pressed.
keyUp          = 4   Character key released.
autoKey        = 5   Key held down in excess of autoKey threshold.
updateEvt      = 6   Window needs to be redrawn.
activateEvt    = 8   Activate/deactivate window.
osEvt          = 15  Operating system event (suspend, resume or mouse moved).
```

**message** Contains additional information about the event. The content of this field depends on the event type, as follows:

<i>Event Type</i>	<i>Contents of message Field</i>
nullEvent	Undefined.
MouseDown	
mouseUp	
keyDown	Bits 0-7 = character code. Bits 8-15 = virtual key code.
keyUp	Bits 16-23 = For Apple Desktop Bus keyboards, the
autoKey	ADB address of the keyboard where the event occurred.



<i>Event Type</i>		<i>Contents of message Field</i>
updateEvt		Pointer to the window to update, activate or deactivate. (For an activateEvt, Bit 0 of the modifiers field indicates whether to activate or deactivate the window.)
activateEvt		
osEvt	resume	Bits 24-31 = suspendResumeMessage constant. Also, a 1 in Bit 0 to indicate that the event is a resume event. Also, a 0 or a 1 in Bit 1 to indicate if clipboard conversion is required.
osEvt	suspend	Bits 24-31 = suspendResumeMessage constant. Also, a 0 in Bit 0 to indicate that the event is a suspend event.
osEvt	mouse-moved	Bits 24-31 = mouseMovedMessage constant.

The following constants may be used to extract certain data from, and to test certain bits in, the message field:

```

charCodeMask      = 0x000000FF  Mask to extract ASCII character code.
keyCodeMask       = 0x0000FF00  Mask to extract key code.
osEvtMessageMask  = 0xFF000000  Mask to extract OS event message code.
mouseMovedMessage = 0x00FA      osEvts: mouse-moved event?
suspendResumeMessage = 0x0001    osEvts: suspend/resume event?
resumeFlag        = 1           osEvts: resume event or suspend event?

```

For example, the following code example determines whether an event which has previously been determined to be an Operating System event is a resume event, a suspend event, or a mouse-moved event. In this example, the high byte of the message field is examined to determine whether it contains suspendResumeMessage (0x0001) or mouseMovedMessage (0x00FA). If it contains suspendResumeMessage, Bit 0 is then examined to determine whether the event is a suspend event or a resume event.

```

switch((eventStrucPtr->message >> 24) & 0x000000FF)
{
    case suspendResumeMessage:
        if((eventRecPtr->message & resumeFlag) == 1)
            // This is a resume event.
        else
            // This is a suspend event.
        break;

    case mouseMovedMessage:
        // This is a mouse-moved event.
        break;
}

```

when Time the event was posted, in ticks since system startup. (A tick is approximately 1/60th of a second.) Typically, this is used to establish the time between mouse clicks.

where Location of cursor, in global coordinates, at the time the event was posted.

### NOTE

Global coordinates are explained at Chapter 4.

**modifiers** Contains information about the state of the modifier keys and the mouse button at the time the event was posted.

For activate events, this field indicates whether the window should be activated or deactivated.

For mouse-down events, this field indicates whether the event caused the application to be switched to the foreground.

<i>Bit</i>	<i>Description</i>
Bit 0	activateEvt: 1 if the window pointed to in the message field should be activated. 0 if the window pointed to in the message field should be deactivated.  mouseDown: 1 if the event caused the application to be switched to the foreground, otherwise 0.
Bit 7	1 if mouse button was up, 0 if not.
Bit 8	1 if Command key down, 0 if not.
Bit 9	1 if Shiftkey down, 0 if not.
Bit 10	1 if Caps Lock key down, 0 if not.
Bit 11	1 if Option key down, 0 if not.
Bit 12	1 if Control key down, 0 if not.
Bit 13	1 if Right Shift Key down, 0 if not.
Bit 14	1 if Right Option Key down, 0 if not.
Bit 15	1 if Right Control Key down, 0 if not.

The following constants may be used as masks to test the setting of the various bits in the **modifiers** field:

```

activeFlag    = 0x0001  Window is to be activated? (activateEvt).
                  Foreground switch? (mouseDown).
btnState      = 0x0080  Mouse button up?

```

```

cmdKey      = 0x0100  Command key down?
shiftKey    = 0x0200  Shift key down?
AlphaLock   = 0x0400  Caps Lock key down?
optionKey   = 0x0800  Option key down?
controlKey  = 0x1000  Control key down?
rightShiftKey = 0x2000  Right Shift Key down?
rightOptionKey = 0x4000  Right Option Key down?
rightControlKey = 0x8000  Right Control Key down?

```

For example, the following code example determines whether an event which has previously been determined to be an activate event is intended to signal the application to activate or deactivate the window referenced in the message field:

```

Boolean becomingActive;

becomingActive = ((eventStrucPtr->modifiers & activeFlag) == activeFlag);

if(becomingActive)
    // Window activation code here.
else
    // Window deactivation code here.

```

## Event Structure Examples—Diagrammatic

Fig 3 is a diagrammatic representation of the contents of some typical event structures.

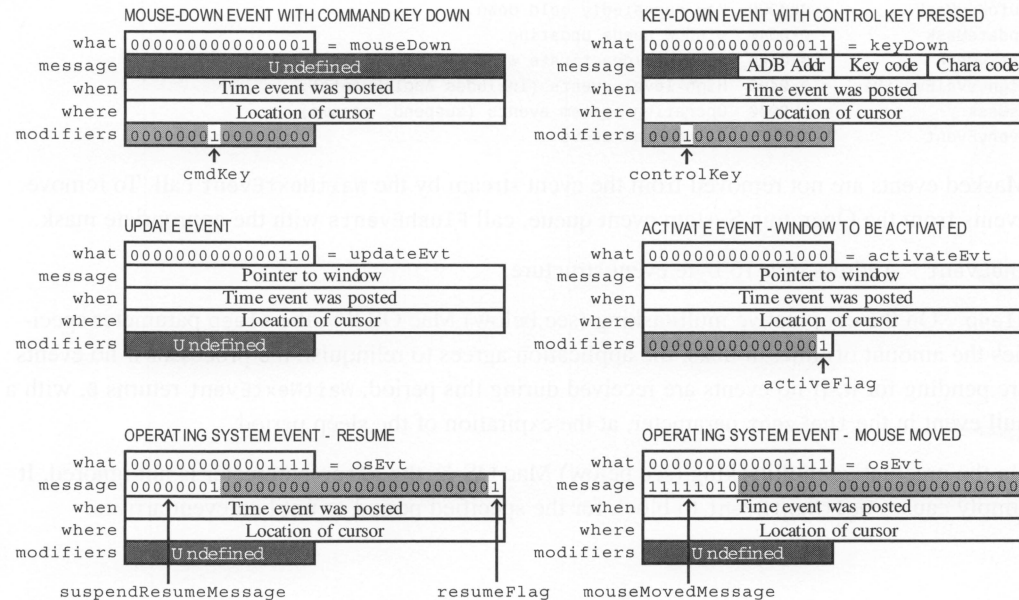


FIG 3 - EXAMPLES OF CONTENTS OF AN EVENT RECORD

## The WaitNextEvent Function

The `WaitNextEvent` function retrieves events from the Event Manager. If no events are pending for the application, the `WaitNextEvent` function may allocate processor time to other applications. When `WaitNextEvent` returns, the event structure contains information about the retrieved event, if any.

`WaitNextEvent` returns `true` if it retrieves any event other than a null event. If there are no events of the types specified in the `eventMask` parameter (other than null events), `false` is returned.

```
Boolean WaitNextEvent(EventMask eventMask, EventRecord *theEvent, UInt32 sleep,
                     RgnHandle mouseRgn)
```

**Returns:** A return code: 0 = null event; 1 = event returned.

**eventMask** A 16-bit binary mask which may be used to mask out the receipt of certain events.

The following constants are defined in `Events.h`:

```
mDownMask      = 0x0002  Mouse button pressed.
mUpMask        = 0x0004  Mouse button released.
keyDownMask    = 0x0008  Key pressed.
keyUpMask      = 0x0010  Key released.
AutoKeyMask    = 0x0020  Key repeatedly held down.
updateMask     = 0x0040  Window needs updating.
activMask      = 0x0100  Activate/deactivate window.
highLevelEventMask = 0x0400 High-level events (includes AppleEvents).
osMask         = 0x8000  Operating system events (suspend, resume).
everyEvent     = 0xFFFF  All of the above.
```

Masked events are not removed from the event stream by the `WaitNextEvent` call. To remove events from the Operating System event queue, call `FlushEvents` with the appropriate mask.

**theEvent** Address of a 16-byte event structure.

**sleep** On the cooperative multitasking (see below) Mac OS 8/9, the `sleep` parameter specifies the amount of time, in ticks, the application agrees to relinquish the processor if no events are pending for it. If no events are received during this period, `WaitNextEvent` returns 0, with a null event in the `theEvent` parameter, at the expiration of the `sleep` period.

On the preemptive multitasking (see below) Mac OS X, the `sleep` parameter is not ignored. It simply causes `WaitNextEvent` to block for the specified period or until an event arrives.

### Carbon Note

In order to give drivers time to run, the Classic `WaitNextEvent` will often return long before the sleep time that you pass to it has expired. The Carbon `WaitNextEvent` does not do this; it always waits the full sleep time.

`mouseRgn` The screen **region** inside which the Event Manager does not generate mouse-moved events. The region should be specified in global coordinates. If the user moves the cursor outside this region and the application is the foreground process, the Event Manager reports mouse-moved events.

If `NULL` is passed as this parameter, the Event Manager does not return mouse-moved events.

Before returning to the application, `WaitNextEvent` performs certain additional processing and may, in fact, intercept the received event so that it is never received by your application. As will be seen, key-up and key-down events are intercepted in this way in certain circumstances.

## The sleep Parameter and Multitasking

### Cooperative Multitasking—Mac OS 8/9

The yielding of access to the CPU by the foreground process, via `WaitNextEvent`'s sleep parameter, is central to the form of multitasking provided by the Mac OS 8/9 system software. That form of multitasking is known as **cooperative multitasking**.

Under cooperative multitasking, individual applications continue executing until they “decide” to release control, thus allowing the background process of another application to begin executing. Even though this results in a usable form of multitasking, the operating system itself does not control the processor's scheduling. Even under the best of circumstances, an individual application (which has no way of knowing what other applications are running or whether they have a greater “need” to execute) makes inefficient use of the processor, which often results in the processor idling when it could be used for productive work.

Note also that, under this cooperative scheme, the assignment of zero to `WaitNextEvent`'s sleep parameter will cause your application to completely “hog” the CPU whenever it is in the foreground, allowing no CPU time at all to the background processes.

### Preemptive Multitasking—Mac OS X

Under **preemptive multitasking**, the operating system itself retains control of which body of code executes, and for how long. No longer does one task have to depend on the good will of another task—that is, the second task's surrender of control—to gain access to the CPU.

## Flushing the Operating System Event Queue

Immediately after application launch, the `FlushEvents` function should be called to empty the Operating System event queue of any low-level events left unprocessed by another application—for example, any mouse-down or keyboard events that the user might have entered while the Finder launched the application.

## Handling Events

### Handling Mouse Events

Your application receives mouse-down events only when it is the foreground process and the user clicks in a window belonging to the application or in the menu bar. (If the user clicks in a window belonging to another application, your application receives a suspend event.)

#### NOTE

Events related to the *movement* of the mouse are not stored in the event queue. The mouse driver automatically tracks the mouse and displays the cursor as the user moves the mouse.

The first action on receipt of a mouse-down event is to determine where the cursor was when the mouse button was pressed. A call to `FindWindow` will determine

- Which of your application's windows, if any, the mouse button was pressed in.
- Which window part the mouse button was pressed in. In this context, a window part includes the menu bar as well as various regions within the window.

The following constants, defined in `MacWindows.h`, may be used to test the value returned by `FindWindow`:

<code>inDesk</code>	<code>= 0</code>	In none of the following.
<code>inNoWindow</code>	<code>= 0</code>	In none of the following.
<code>inMenuBar</code>	<code>= 1</code>	In the menu bar.
<code>inContent</code>	<code>= 3</code>	Anywhere in the content region except the grow region if the window is active. Anywhere in the content region including the grow region if the window is inactive.
<code>inDrag</code>	<code>= 4</code>	In the drag region.
<code>inGrow</code>	<code>= 5</code>	In the grow/resize region (active window only).
<code>inGoAway</code>	<code>= 6</code>	In the close region (active window only).
<code>inZoomIn</code>	<code>= 7</code>	In the zoom-in region (active window only).
<code>inZoomOut</code>	<code>= 8</code>	In the zoom-out region (active window only).
<code>inCollapseBox</code>	<code>= 11</code>	In the collapse/minimize region (active window only).
<code>inProxyIcon</code>	<code>= 12</code>	In the window proxy icon (active window only).



## In the Content Region

If the cursor was in the content region of the active window, your application should perform the action that is appropriate to the application. If the window has scroll bars, which actually occupy part of the content region, your application should first determine whether the cursor was in the scroll bars—or, indeed, in any other control—and respond appropriately.

### NOTE

The content region is the part of the window in which an application displays the contents of a document and the window's controls (for example, scroll bars).

## In the Title Bar, Size Box, Zoom Box, Close Box, Collapse Box, or Window Proxy Icon

### NOTE

In the following, Mac OS 8/9 terminology is used. **Size box** equates to **resize control**. **Zoom box** equates to **zoom button**. **Close box** equates to **close button**. **Collapse box** equates to **minimize button**.

If the cursor was in one of the noncontent regions of the active window, your application should perform the appropriate actions for that region as follows:

- **Title Bar.** If the cursor was in the title bar, your application should do one of the following:
  - Call `DragWindow` to allow the user to drag the window to a new location. `DragWindow` retains control until the mouse button is released (see Chapter 4).
  - Use an alternative approach introduced with the Mac OS 8.5 Window Manager which first involves a call to `IsWindowPathSelect` to determine whether the mouse-down event should activate the window path pop-up menu. If `IsWindowPathSelect` returns true, your application should then call `WindowPathSelect` to display the menu, otherwise your application should call `DragWindow` to allow the user to drag the window to a new location (see Chapter 16).

- **Size Box.** If the cursor was in the size box, your application should call to `ResizeWindow`, which tracks user actions while the mouse button remains down. When the mouse button is released, `ResizeWindow` draws the window in its new size.
- **Zoom Box.** If the cursor was in the zoom box, your application should call to `IsWindowInStandardState` to determine whether the window is currently in the standard state or the user state. `ZoomWindowIdeal` should then be called to zoom the window to the appropriate state, and the window's content region should be redrawn.
- **Close Box.** If the cursor was in the close box, your application should call `TrackGoAway` to track user actions while the mouse button remains down. `TrackGoAway`, which returns only when the mouse is released, returns `true` if the cursor is still inside the close box when the mouse button is released, and `false` otherwise.
- **Collapse Box.** If the cursor was in the collapse box, your application should do nothing, because the system will collapse (Mac OS 8/9) or minimize (Mac OS X) the window for you.
- **Window Proxy Icon.** If the cursor was in the window proxy icon, your application should call `TrackWindowProxyDrag`, which handles all aspects of the drag process while the user drags the proxy icon (see Chapter 16).

### In the Menu Bar

If the cursor was in the menu bar, your application should first adjust its menus—that is, enable and disable items and set marks (for, example, checkmarks) based on the context of the active window. It should then call `MenuSelect`, which handles all user action until the mouse button is released.

When the mouse button is released, `MenuSelect` returns a long integer containing, ordinarily, the menu ID in the high word and the chosen menu item in the low word. However, if the cursor was outside the menu when the button was released, the high word contains 0.

### In an Inactive Application Window

If the mouse click was in an inactive application window, `FindWindow` can return only the `inContent` or `inDrag` constant. If `inContent` is reported, your application should bring the inactive window to the front using `SelectWindow`.

Ordinarily, the first click in an inactive window should simply activate the window and do nothing more. However, if the mouse click is in the title bar, for example, you could elect to have your application activate the window *and* allow the user to drag the window to a new location, all on the basis of the first mouse-down.

## Detecting Mouse Double Clicks

Double clicks can be detected by comparing the time of a mouse-up event with that of an immediately following mouse-down. `GetDoubleTime` returns the time difference required for two mouse clicks to be interpreted as a double click.

## Handling Keyboard Events

After retrieving a key-down event, an application should determine which key was pressed and which modifier keys (if any) were pressed at the same time. Your application should respond appropriately when the user presses a key or combination of keys. For example, your application should allow the user to choose a frequently used menu command by using its keyboard equivalent.

## Character Code and Virtual Key Code

The low-order word in the message field contains the **character code** and **virtual key code** corresponding to the key pressed by the user.

For a specific key on a particular keyboard, the virtual key code is always the same. The system uses a key-map ('KMAP') resource to determine the virtual key code that corresponds to a specific physical key.

The system software then takes this virtual key code and uses a keyboard layout ('KCHR') resource to map the virtual keycode to a specific character code. Any given script system (that is, writing system) has one or more 'KCHR' resources (for example, a French 'KCHR' and a U.S. 'KCHR') which determine whether virtual key codes are mapped to, again for example, the French or the U.S. character set.

Generally speaking, your application should use the character code rather than the virtual key code when responding to keyboard events. The following constants may be used as masks to access the virtual key code and character code in the message field:

```
keyCodeMask = 0x0000FF00 Mask to extract key code.  
charCodeMask = 0x000000FF Mask to extract ASCII character code.
```

## Checking for Keyboard Equivalents

In its initial handling of key-down and auto-key events, the application should first extract the character code from the message field and then check the `modifiers` field to determine if the Command key was pressed at the time of the event. If the Command key was down, the menus should be adjusted prior to further processing of the event. This further processing must necessarily accommodate the possibility that one or more of the modifier keys (Shift, Option, and Control) were also down at the same time as the Command key. If the Command key was not down, the appropriate function should be called to further handle the event.

**NOTE**

A menu item can be assigned a keyboard equivalent, that is, any combination of the Command key, optionally one or more modifier keys (Shift, Option, Control), and another key. A Command-key equivalent such as Command-C is also a keyboard equivalent.

## Checking For a Command-Period Key Combination

Your application should allow the user to cancel a lengthy operation by using the Command-period combination. This can be implemented by periodically examining the state of the keyboard using `GetKeys` or, alternatively, by calling `CheckEventQueueForUserCancel` to scan the event queue for a Command-period keyboard event. The demonstration program at Chapter 25 contains a demonstration of the latter method.

## Events Not Returned to the Application

Certain keyboard events will not, or may not, be returned to your application. These are as follows:

- **Command-Shift-Numeric Key Combinations.** Some keystroke combinations are handled by the Event Manager and are thus not returned to your application. These include certain Command-Shift-numeric key combinations, for example (on Mac OS 8/9), Command-Shift-3 to take a snapshot of the screen. These key combinations invoke a function that takes no parameters and which is stored in an 'FKEY' resource with a resource ID corresponding to the number key in the Command-Shift-numeric key combination. (Note that IDs of 1 to 4 are reserved by Apple.)

### Carbon Note

Function key functions are not supported in Carbon.

- **Key-Up Events.** At application launch, the Operating System initializes another event mask, called the **system event mask**, to exclude key-up messages. If an application needs to receive key-up events, the system event mask must be changed using the `SetEventMask` function.

## Handling Update Events

### Handling Update Events—Mac OS 8/9

#### The Update Region

On Mac OS 8/9, when one window covers another and the user moves the front window, the Window Manager generates an update event so that the contents of the newly exposed area of the rear window can be updated (redrawn).

The Window Manager keeps track of all areas of a window's content region that need to be redrawn and accumulates them in a region called the **update region**. When the application calls `WaitNextEvent`, the Event Manager determines whether any windows have a non-empty update region. If a non-empty update region is found, the Event Manager reports an update event to the appropriate application. Update events are issued for the front window first when more than one window needs updating.

#### Updating the Window

Upon receiving the update event, your application should first call `BeginUpdate`, which temporarily replaces the **visible region** of the window's graphics port with the intersection of the visible region and the update region and then clears the update region. This process is explained in more detail in Chapter 4. (If the update region is not cleared, the Event Manager will continue to send an endless stream of update events. Accordingly, it is absolutely essential that `BeginUpdate` be called in response to all update events.)

Your application should then draw the window's contents. (Note that, to prevent the unnecessary drawing of unaffected areas of the window, the system limits redrawing to the visible region, which at this point corresponds to the update region as it was before `BeginUpdate` cleared it.)

`EndUpdate` should then be called to restore the normal visible region.

Update functions should first determine if the window is a document window or a modeless dialog and call separate functions for redrawing the window or the dialog accordingly (see Chapter 8).

### Handling Update Events—Mac OS X

On Mac OS X, windows are double-buffered, meaning that your application does not draw into the window's graphics port itself but rather into a separate buffer. The Window Manager flushes the buffer to the window's graphics port when your application calls `WaitNextEvent`. On Mac OS X, your application does not require update events to cater for the situation where part, or all, of a window's content region has just been exposed as a result of the user moving an overlaying window.



On Mac OS X, the receipt of an update event simply means that your application should draw the required contents of the window. The swapping of visible and update regions required on Mac OS 8/9 is not required, so calls to `BeginUpdate` and `EndUpdate` are irrelevant (and ignored) on Mac OS X.

## Updating Windows in the Background

Recall that your application will receive update events when it is in the background if the application's 'SIZE' resource so specifies.

## Handling Activate Events

Whenever your application receives a mouse-down event, it should first call `FindWindow` to determine if the user clicked in a window other than the active window. If the click was, in fact, in a window other than the active window, `SelectWindow` should be called to begin the process of activating that window and deactivating the currently active window.

`SelectWindow` does some of the activation/deactivation work for you, such as removing the highlighting from the window being deactivated and highlighting the window being activated. It also generates two activate events so that, at your application's next two requests for an event, an activate event is returned for the window being deactivated followed by an activate event for the window being activated. In response, your application must complete the action begun by `SelectWindow`, performing such actions as are necessary to complete the activation or deactivation process. Such actions might include, for example, showing or hiding the scroll bars, restoring or removing highlighting from any selections, adjusting menus, and so on.

The message field of the event structure contains a reference to the window being activated or deactivated and bit 0 of the `modifiers` field indicates whether the window is being activated or deactivated. The `activeFlag` constant may be used to test the state of this bit.

### Carbon Note

When the user switches between your application and another application, your application is notified of the switch through Operating System (suspend and resume) events.

In a Classic application, if the application's 'SIZE' resource has the `acceptSuspendResumeEvents` flag set and the `doesActivateOnFGSwitch` flag not set, your application receives an activate event immediately following all suspend and resume events. This means that the application can rely on the receipt of those activate events to trigger calls to its window activation/deactivation functions when a major switch occurs.



On the other hand, if a Classic application has both the `acceptSuspendResumeEvents` and the `doesActivateOnFGSwitch` flags set, it does not receive an activate event immediately following suspend and resume events. In this case, the application must call its window activation/deactivation functions whenever it receives a suspend or resume event, in addition to the usual call made in response to an activate event.

The generally accepted practice in Classic applications is to set the `doesActivateOnFGSwitch` flag whenever the `acceptSuspendResumeEvents` flag is set.

In a Carbon application, activate events are invariably received along with all suspend and resume events regardless of the `doesActivateOnFGSwitch` flag setting. This would suggest that the `doesActivateOnFGSwitch` flag is irrelevant in a Carbon application and need never be set. However, the correct generation of activate events requires that this flag always be set in a Carbon application.

The upshot is that, in Carbon applications, and despite the fact that the `doesActivateOnFGSwitch` flag should still be set, window activation/deactivation functions need never be called on suspend and resume events.

## Handling Null Events

The Event Manager reports a null event when the application requests an event and the application's event stream does not contain any of the requested event types. The `WaitNextEvent` function reports a null event by returning `false` and placing `nullEvt` in the `what` field.

When your application receives a null event, and assuming it is the foreground process, it can perform what is known as **idle processing**, such as blinking the insertion point caret in the active window of the application.

As previously stated, your application's 'SIZE' resource can specify that the application receive null events while it is in the background. If your application receives a null event while it is in the background, it can perform tasks or do other processing.

In order not to deny a reasonable amount of processor time to other applications, idle processing and background processing should generally be kept to a minimum.

## Handling Suspend and Resume Events

When an Operating System event is received, the message field of the event structure should be tested with the constants `suspendResumeMessage` and `mouseMovedMessage` to determine what type of event was received. If this test reveals that the event was a suspend or resume event, bit 0 should be tested with the constant `resumeFlag` to ascertain whether the event was a suspend event or a resume event.

`WaitNextEvent` returns a suspend event when your application has been switched to the background and returns a resume event when your application becomes the foreground process.

### Carbon Note

There is a fundamental difference between the receipt of suspend events in Carbon applications as compared with Classic applications. In Classic applications, suspend events are received when your application is *about* to be switched to the background, that is, the application does not actually switch to the background until it makes its next request to receive an event from the Event Manager. In Carbon applications, suspend events are received *after* the application has been switched to the background.

On receipt of a suspend event, your application should do anything necessary to reflect the fact that it is now in the background. When an application receives a resume event, it should do anything necessary to reflect the fact that it is now in the foreground and set the mouse cursor to the arrow shape.

## Handling Mouse-Moved Events

Mouse-moved events are used to trigger a change in the appearance of the cursor according to its position in a window. For example, when the user moves the cursor outside the text area of a document window, applications typically change its shape from the I-beam shape to the standard arrow shape.

The main requirement is to specify a region in the `mouseRgn` parameter of the `WaitNextEvent` function. This causes the Event Manager to report a mouse-moved event if the user moves the cursor outside that region. On receipt of the mouse-moved event, the application can change the shape of the cursor.

An application might define two regions: a region which encloses the text area of a window (the I-beam region) and a region which defines the scroll bars and all other areas outside the text area (the arrow region). By specifying the I-beam region to `WaitNextEvent`, the mouse driver continues to display the I-beam cursor until the user moves the cursor out of this region. When the cursor moves outside the region, `WaitNextEvent` reports a mouse-moved event. Your application can then change the I-beam cursor to the arrow cursor and change the `mouseRgn` parameter to the non-I-beam region. The cursor now remains an arrow until the user moves the cursor out of this region, at which point your application receives another mouse-moved event.

The application must, of course, recalculate and change the `mouseRgn` parameter immediately when it receives a mouse-moved event. Otherwise, mouse-moved events will be continually received as long as the cursor is outside the original region.

The appearance of the cursor may be changed using the QuickDraw function `SetCursor` or the Appearance Manager function `SetThemeCursor` (see Chapter 6 and Chapter 13).

Cursor setting functions should account for whether a document window or modeless dialog is active and set the cursor appropriately.

## Handling Events in Alerts and Dialogs

The handling of events in alerts and dialogs is addressed in detail in Chapter 8. The following is a brief overview only.

### Modal and Movable Modal Alerts

The Dialog Manager functions `Alert`, `NoteAlert`, `CautionAlert`, `StopAlert`, and `StandardAlert` are used to invoke modal and movable modal alerts and to handle all user interaction while the alert remains open. The Dialog Manager handles all the events generated by the user until the user clicks a button (typically, the OK or Cancel button). When the user clicks the OK or Cancel button, the Dialog Manager closes the alert and reports the user's action to the application, which is responsible for performing any appropriate subsequent actions.

### Modal and Movable Modal Dialogs

For modal and movable modal dialogs, the Dialog Manager function `ModalDialog` is used to handle all user interaction while the dialog is open. When the user selects an item, `ModalDialog` reports the selection to the application, in which case the application is responsible for performing the action associated with that item. An application typically calls `ModalDialog` repeatedly, responding to clicks on enabled items as reported by `ModalDialog`, until the user selects the OK or Cancel button.

### Modeless Dialogs

For modeless dialogs, you can use the function `IsDialogEvent` to determine whether the event occurred while a modeless dialog was the frontmost window and then, optionally, use the function `DialogSelect` to handle the event if it belongs to a modeless dialog. `DialogSelect` is similar to `ModalDialog` except that it returns control after every event, not just events relating to an enabled item.

## The 'SIZE' Resource

Several references have been made in the preceding to the application's 'SIZE' resource because some (though not all) of the flag fields in this resource are relevant to the subject of events.

An application's 'SIZE' resource informs the Operating System

- About the memory requirements of the application
- About certain scheduling options (for example, whether the application can accept suspend and resume events)
- Whether the application
  - Supports stationery documents
  - Supports TextEdit's inline input services
  - Wishes to receive notification of the termination of any application it has launched
  - Wishes to receive high-level events

The 'SIZE' resource comprises a 16-bit flags field, which specifies the operating characteristics of your application, followed by two 32-bit size fields, one indicating the minimum size, and one the preferred size, of the application's partition.

## Resource ID

The 'SIZE' resource created for your application should have a resource ID of -1. If, on Mac OS 8/9, the user modifies the preferred size in the Finder's Get Info window, the Operating System creates a new 'SIZE' resource having an ID of 0. If it exists, this latter resource will be invoked by the Operating System at application launch. If it does not exist, the Process Manager looks for the original 'SIZE' resource with ID -1.

## Creating a 'SIZE' Resource in CodeWarrior

It is possible to create a 'SIZE' resource using Resorcerer; however, it is far more convenient to use the built-in 'SIZE' resource creation facility within CodeWarrior.

**Flags Fields.** In CodeWarrior, the bits of the flags field can be set as desired using the 'SIZE' Flags pop-up menu in the PPC Target sections of the Settings dialog, which appears when <Project Name> Settings... is chosen from the Edit Menu. The following describes the meanings of the items in the pop-up menu, and thus of the relevant bits of the 16-bit flags field. Those items relevant to low-level and Operating System events appear on a gray background.

<i>'SIZE' Flags Pop-Up Menu</i>	<i>Meaning When Set</i>	<i>Meaning When Not Set</i>
acceptSuspendResumeEvents	Your application can process, and thus wants to receive suspend and resume events. (When this flag is set, the doesActivateOnFGSwitch flag should also normally be set.)	Your application does not want to receive suspend and resume events.
canBackground	Your application wants to receive null event processing time while in the background and/or your application wants to receive suspend events.	Your application does no background processing and thus does not want to receive null events when it is in the background and/or your application does not want to receive suspend events.
doesActivateOnFGSwitch	<p>In Classic applications, setting this flag means that your application does not want to receive activate events associated with suspend and resume events, and will thus activate and deactivate its windows in response to suspend and resume events as well as activate events.</p> <p>In a Carbon application, activate events are invariably received along with all suspend and resume events regardless of the doesActivateOnFGSwitch flag setting. This would suggest that the doesActivateOnFGSwitch flag is irrelevant in a Carbon application and need never be set. However, the correct generation of activate events requires that this flag always be set in a Carbon application.</p>	
onlyBackground	Your application runs only in the background. (Usually, this is because it does not have a user interface and cannot run in the foreground.)	Your application runs in the foreground and the background.



<i>'SIZE' Flags Pop-Up Menu</i>	<i>Meaning When Set</i>	<i>Meaning When Not Set</i>
<code>getFrontClicks</code>	Your application wants to receive the mouse-down and mouse-up events that are used to bring your application into the foreground when the user clicks in your application's frontmost window.	Your application does not want to receive the mouse-down and mouse-up events that are used to bring your application into the foreground.
<code>acceptAppDiedEvents</code>	Your application wants to be notified whenever an application launched by your application terminates or crashes. (This information is received via an Apple event.)	Your application does not want to be notified whenever an application launched by your application terminates or crashes.
<code>is32BitCompatible</code>	In pre-Mac OS 8 versions of the system software, setting this flag indicated that your application could be run with either the 32-bit Memory Manager or the 24-bit Memory Manager. Unsetting this flag indicated that your application could not be run with the 32-bit Memory Manager. No Power Macintosh supports the 24-bit mode. Accordingly, this flag is irrelevant in Carbon and should be left unset.	
<code>isHighLevelEventAware</code>	Your application can send and receive high-level events. Your application must support the four required Apple events if this flag is set (see Chapter 10).	The Event Manager does not give your application high-level events when it calls <code>WaitNextEvent</code> .
<i>For reasons unknown, this flag must always be set in Carbon applications. If this flag is not set, this alert will appear at compile time "Could not launch (application name) because the library "&gt;&gt;CarbonLib&lt;&lt;" could not be found."</i>		
<code>localAndRemoteHLEvents</code>	Your application is to be visible to applications running on other computers on a network.	Your application does not receive high-level events across a network.



<i>'SIZE' Flags Pop-Up Menu</i>	<i>Meaning When Set</i>	<i>Meaning When Not Set</i>
isStationeryAware	Your application can recognize stationary documents.	Your application cannot recognize stationary documents. If the user opens a stationary document, the Finder duplicates the document and prompts the user for a name for the duplicate document.
useTextEditServices	Your application can use the inline text services provided by TextEdit.	Your application cannot use the inline text services provided by TextEdit.
isDisplayManagerAware	Your application can handle the Display Notice event, which tells your application to move its windows after the monitor settings have changed.	When the monitor settings are changed, the DisplayManager moves your application's windows so that they do not disappear off the screen.

**Size Fields.** For Mac OS 8/9, the minimum and preferred sizes of the application's partition may be set in the Preferred Heap Size (k) and MinimumHeap Size (k) sections of the PPC Target section of the Settings dialog.

## Main Event Manager Constants, Data Types and Functions

### Constants

#### Event Codes

nullEvent	= 0	No other pending events.
mouseDown	= 1	Mouse button pressed.
mouseUp	= 2	Mouse button released.
keyDown	= 3	Character key pressed.
keyUp	= 4	Character key released.
autoKey	= 5	Key held down in excess of autoKey threshold.
updateEvt	= 6	Window needs to be redrawn.
activateEvt	= 8	Activate/deactivate window.
osEvt	= 15	Operating system event (suspend, resume or mouse moved).

## Event Masks

mDownMask	= 0x0002	Mouse button pressed.
mUpMask	= 0x0004	Mouse button released.
keyDownMask	= 0x0008	Key pressed.
keyUpMask	= 0x0010	Key released.
autoKeyMask	= 0x0020	Key repeatedly held down.
updateMask	= 0x0040	Window needs updating.
activMask	= 0x0100	Activate/deactivate window.
highLevelEventMask	= 0x0400	High-level events (includes AppleEvents).
osMask	= 0x8000	Operating system events (suspend, resume).
everyEvent	= 0xFFFF	All of the above.Event Message

## Masks for Keyboard Events

keyCodeMask	= 0x0000FF00	Mask to extract key code.
charCodeMask	= 0x000000FF	Mask to extract ASCII character code.

## Message Codes for Operating System Events

osEvtMessageMask	= 0xFF000000	Mask to extract OS event message code.
mouseMovedMessage	= 0x00FA	For osEvts, test for mouse-moved event.
suspendResumeMessage	= 0x0001	For osEvts, test for suspend/resume event.
resumeFlag	= 1	For osEvts, test Bit 0.

## Constants Corresponding to Bits in the Modifiers Field

activeFlag	= 0x0001	Set if window being activated (activateEvt). Set if event caused a foreground switch (mouseDown).
btnState	= 0x0080	Set if mouse button up.
cmdKey	= 0x0100	Set if Command key down.
shiftKey	= 0x0200	Set if Shift key down.
alphaLock	= 0x0400	Set if Caps Lock key down.
optionKey	= 0x0800	Set if Option key down.
controlKey	= 0x1000	Set if Control key down.
rightShiftKey	= 0x2000	Set if Right Shift Key down.
rightOptionKey	= 0x4000	Set if Right Option Key down.
rightControlKey	= 0x8000	Set if Right Control Key down.

## Data Types

### Event Structure

```
struct EventRecord
{
    EventKind    what;        // Event code.
    UInt32      message;     // Event message.
    UInt32      when;        // Ticks since system startup.
    Point        where;      // Mouse location in global coordinates.
    EventModifiers modifiers; // Modifier flags.
} EventRecord;
typedef struct EventRecord EventRecord;
```

## Functions

### Receiving Events

```
Boolean  WaitNextEvent(EventMask eventMask, EventRecord *theEvent, UInt32 sleep,
                      RgnHandle mouseRgn);
Boolean  EventAvail(EventMask eventMask, EventRecord *theEvent);
void     FlushEvents(EventMask whichMask, EventMask stopMask);
Boolean  GetNextEvent(EventMask eventMask, EventRecord *theEvent)
void     SetEventMask(EventMask value);
```

### Reading the Mouse

```
void     GetMouse(Point *mouseLoc);
Boolean  Button(void);
Boolean  StillDown(void);
Boolean  WaitMouseUp(void);
```

### Reading the KeyBoard

```
void     GetKeys(KeyMap theKeys);
UInt32   KeyTranslate(const void *transData, UInt16 keycode, UInt32 *state);
```

### Getting Timing Information

```
UInt32   TickCount(void);
UInt32   GetDbtTime(void);
UInt32   GetCaretTime(void);
```

## Demonstration Program LowEvents Listing

```
// *****
// LowEvents.c                                CLASSIC EVENT MODEL
// *****
//
// This program contains a main event loop function, together with subsidiary
// functions which perform nominal handling only of low-level and Operating
// System events. It opens a window in which the types of all received
// low-level and Operating System events are displayed. It terminates when the
// user clicks the window's close box.
//
// Event handling is only nominal in this program because its main purpose is
// to demonstrate the basics of an application's main event loop. Programs in
// later chapters demonstrate the full gamut of individual event handling.
//
// The program utilises the following resources:
//
// • A 'plst' resource.
//
// • A 'WIND' resource (purgeable).
//
// • A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
```

```
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rWindowResource 128

#define topLeft(r) (((Point *) &(r))[0])
#define botRight(r) (((Point *) &(r))[1])

// ..... global variables

Boolean gDone;
RgnHandle gCursorRegionHdl;

// ..... function prototypes

void main (void);
void doPreliminaries (void);
void doNewWindow (void);
void eventLoop (void);
void doEvents (EventRecord *);
void doMouseDown (EventRecord *);
void doUpdate (EventRecord *);
void doOSEvent (EventRecord *);
void drawEventString (Str255);
void doAdjustCursor (WindowRef);

// ***** main

void main(void)
{
    doPreliminaries();
    doNewWindow();
    eventLoop();
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(48);

    InitCursor();
    FlushEvents(everyEvent,0);
}

// ***** doNewWindow
```

```

void doNewWindow(void)
{
    WindowRef windowRef;

    if(!(windowRef = GetNewCWindow(rWindowResource,NULL,(WindowRef) -1)))
    {
        SysBeep(10);
        ExitToShell();
    }

    SetPortWindowPort(windowRef);
    TextSize(10);
}

// ***** eventLoop

void eventLoop(void)
{
    EventRecord eventStructure;
    Boolean      gotEvent;

    gDone = false;
    gCursorRegionHdl = NewRgn();
    doAdjustCursor(FrontWindow());

    while(!gDone)
    {
        gotEvent = WaitNextEvent(everyEvent,&eventStructure,180,gCursorRegionHdl);
        if(gotEvent)
            doEvents(&eventStructure);
        else
        {
            if(eventStructure.what == nullEvent)
                drawEventString("\p    · nullEvent");
        }
    }
}

// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    switch(eventStrucPtr->what)
    {
        case mouseDown:
            drawEventString("\p    · mouseDown");
            doMouseDown(eventStrucPtr);
            break;

        case mouseUp:
            drawEventString("\p    · mouseUp");
            break;
    }
}

```

```

    case keyDown:
        drawEventString("\p      · keyDown");
        break;

    case autoKey:
        drawEventString("\p      · autoKey");
        break;

    case updateEvt:
        drawEventString("\p      · updateEvt");
        doUpdate(eventStrucPtr);
        break;

    case activateEvt:
        drawEventString("\p      · activateEvt");
        break;

    case osEvt:
        drawEventString("\p      · osEvt - ");
        doOSEvent(eventStrucPtr);
        break;
}
}

// ***** doMouseDown

void doMouseDown(EventRecord *eventStrucPtr)
{
    WindowPartCode partCode;
    WindowRef      windowRef;

    partCode = FindWindow(eventStrucPtr->where,&windowRef);

    switch(partCode)
    {
        case inContent:
            if(windowRef != FrontWindow())
                SelectWindow(windowRef);
            break;

        case inDrag:
            DragWindow(windowRef,eventStrucPtr->where,NULL);
            doAdjustCursor(windowRef);
            break;

        case inGoAway:
            if(TrackGoAway(windowRef,eventStrucPtr->where))
                gDone = true;
            break;
    }
}

```



```
// ***** doUpdate

void doUpdate(EventRecord *eventStrucPtr)
{
    BeginUpdate((WindowRef) eventStrucPtr->message);
    EndUpdate((WindowRef) eventStrucPtr->message);
}

// ***** doOSEvent

void doOSEvent(EventRecord *eventStrucPtr)
{
    Cursor arrow;

    switch((eventStrucPtr->message >> 24) & 0x000000FF)
    {
        case suspendResumeMessage:
            if((eventStrucPtr->message & resumeFlag) == 1)
            {
                SetCursor(GetQDGlobalsArrow(&arrow));
                DrawString("\pResume");
            }
            else
                DrawString("\pSuspend");
            break;

        case mouseMovedMessage:
            doAdjustCursor(FrontWindow());
            DrawString("\pMouse-moved");
            break;
    }
}

// ***** drawEventString

void drawEventString(Str255 eventString)
{
    WindowRef windowRef;
    RgnHandle tempRegion;
    Rect portRect;

    windowRef = FrontWindow();
    tempRegion = NewRgn();

    GetWindowPortBounds(windowRef,&portRect);
    ScrollRect(&portRect,0,-15,tempRegion);
    DisposeRgn(tempRegion);

    MoveTo(8,340);
    DrawString(eventString);
}
```

```
// ***** doAdjustCursor

void doAdjustCursor(WindowRef windowRef)
{
    RgnHandle myArrowRegion;
    RgnHandle myIBeamRegion;
    Rect      cursorRect;
    Point     mousePt;
    Cursor     arrow;

    myArrowRegion = NewRgn();
    myIBeamRegion = NewRgn();
    SetRectRgn(myArrowRegion, -32768, -32768, 32767, 32767);

    GetWindowPortBounds(windowRef, &cursorRect);
    SetPortWindowPort(windowRef);
    LocalToGlobal(&topLeft(cursorRect));
    LocalToGlobal(&botRight(cursorRect));

    RectRgn(myIBeamRegion, &cursorRect);
    DiffRgn(myArrowRegion, myIBeamRegion, myArrowRegion);

    GetGlobalMouse(&mousePt);
    if (PtInRgn(mousePt, myIBeamRegion))
    {
        SetCursor(*(GetCursor(iBeamCursor)));
        CopyRgn(myIBeamRegion, gCursorRegionHdl);
    }
    else
    {
        SetCursor(GetQDGlobalsArrow(&arrow));
        CopyRgn(myArrowRegion, gCursorRegionHdl);
    }

    DisposeRgn(myArrowRegion);
    DisposeRgn(myIBeamRegion);
}

// *****
```

## Demonstration Program LowEvents Comments

When the program is run, the user should move the mouse cursor inside and outside the window, click the mouse inside and outside the window, drag the window, and press and release keyboard keys, noting the types of events generated by these actions as printed on the scrolling display inside the window.

The user should also note

- The basic window deactivation and activation that occurs when the mouse is clicked outside, and then inside the window.
- That when another window is positioned over part of the program's window and then dragged to expose more of the program's window, an update event is received on Mac OS 8/9 but not on Mac OS X.

The program may be terminated by a click in the window's close box.

### **defines**

`rWindowResource` establishes a constant for the ID of the 'WIND' resource.

The remaining two lines define two common macros. The first converts the top and left fields of a `Rect` to a `Point`. The second converts the bottom and right field of a `Rect` to a `Point`.

### **Global Variables**

The global variable `gDone` controls the termination of the main event loop and thus of the program. `gCursorRegionHdl` will be assigned the handle to a region to be passed in the `mouseRgn` parameter of the `WaitNextEvent` function.

### **main**

The main function calls the functions for performing certain preliminary actions common to most applications and for creating the window. It then calls the function containing the main event loop.

### **doPreliminaries**

`doPreliminaries` is the standard “do preliminaries” function which will be used in all subsequent Classic event model demonstration programs.

`FlushEvents` empties the Operating System event queue of any low-level events left unprocessed by another application, for example, any mouse-down or keyboard events that the user may have entered while this program was being launched.

### **doNewWindow**

The function `doNewWindow` opens the window in which the types of low-level and Operating System events will be printed as they occur. The 'WIND' resource passed as the first parameter specifies that the window has a close box and a drag (title) bar. The window's graphics port is set as the current port for drawing and the text size is set to 10 points.

## eventLoop

eventLoop is the main event loop.

The global variable gDone is set to false before the event loop is entered. This variable will be set to true when the user clicks on the window's close box. The event loop (the while loop) terminates when gDone is set to true.

The calls to NewRgn and doAdjustCursor have to do with the generation of mouse-moved events. The NewRgn call allocates storage for a Region object and initializes the contents of the region to make it an empty region. As will be seen, this first call to doAdjustCursor defines two regions (one for the arrow cursor and one for the I-Beam cursor) and copies the handle to one of them (depending on the current position of the mouse cursor) to the global variable gCursorRegionHandle.

In the call to WaitNextEvent

- The event mask everyEvent ensures that all types of low-level and Operating System events will be returned to the application (except keyUp events, which are masked out by the system event mask).
- eventStructure is the EventRecord structure which, when WaitNextEvent returns, will contain information about the event.
- 180 represents the number of ticks for which the application agrees to relinquish the processor if no events are pending for it. 180 ticks equates to about three seconds.
- If the cursor is now not within the region passed in the cursorRegion parameter, a mouse-moved event will be generated immediately.

WaitNextEvent returns 1 if an event was pending, otherwise it returns 0. If an event was pending, the program branches to doEvent to determine the type of event and handle the event according to its type. If 0 is returned, and if the what field of the event structure contains nullEvent, "nullEvent" is printed in the window. This will occur every three seconds in the absence of other events.

## doEvents

doEvents handles some events to finality and performs initial handling of others.

On return from WaitNextEvent, the what field of the event structure contains an unsigned short integer that indicates the type of event received. The doEvent function isolates the type of event and switches according to that type.

In this demonstration, the action taken in every case is to print the type of event in the window. In addition, and in the case of mouse-down, update, and Operating System events only, calls to individual event handling functions are made.

Note that, in the case of an Operating System event, `doEvent` will only print "osEvt - " in the window. At this stage, the program has not yet established whether the event is a suspend, resume or mouse-moved event.

Note also that the inclusion of the key-up event handling would be pointless, since key-up events are masked out by the Operating System.

## **doMouseDown**

The function `doMouseDown` handles mouse-down events to completion.

`FindWindow` is called to get a reference to the window in which the event occurred and a part code which indicates the part of that window in which the mouse-down occurred. The function then switches according to that part code.

The `inContent` case deals with a mouse-down in a window's content region. `FrontWindow` returns a reference to the frontmost window. If this is not the same as the reference in the event structure's message field, `SelectWindow` is called to generate activate events and to perform basic window activation and deactivation. (Actually, `SelectWindow` will never be called in this demonstration because the program only opens one window, which is always the front window.)

The `inDrag` case deals with a mouse-down in the window's title bar (Mac OS 8/9) or title bar (Mac OS X). In this case, control is handed over to `DragWindow`, which tracks the mouse and drags the window according to mouse movement until the mouse button is released. A bounding rectangle limiting the area in which the window can be dragged may be passed in `DragWindow`'s third parameter. In Carbon, `NULL` may also be passed in this parameter. This has the effect of setting the third parameter to the bounding box of the "desktop region" (also known as the "gray region"). The desktop region is the region below the menu bar, including all screen real estate in a system equipped with multiple monitors.

The regions controlling the generation of mouse-moved events are defined in global coordinates. The region for the I-Beam cursor is based on the window's graphics port's bounding rectangle. Accordingly, when the window is moved, the new location of the port rectangle, in global coordinates, must be recalculated so that the arrow cursor and I-Beam cursor regions may be redefined. The call to `doAdjustCursor` redefines these regions for the new window location and copies the handle to one of them, depending on the current location of the mouse cursor, to the global variable `gCursorRegionHandle`. (Note that this call to `doAdjustCursor` will also be required, for the same reason, when a window is resized or zoomed.)

The `inGoAway` case deals with the case of a mouse-down in the close box (Mac OS 8/9) or close button (Mac OS X). In this case, control is handed over to `TrackGoAway`, which tracks the mouse while the mouse button remains down. When the button is released, `TrackGoAway` returns true if the cursor is still inside the close box, in which case the global variable `gDone` is set to true, terminating the event loop and the program.

### **doUpdate**

The function `doUpdate` handles update events to completion.

Although no window updating is performed by this program, it is nonetheless necessary to call `BeginUpdate` because `BeginUpdate` clears the update region, thus preventing the generation of an unending stream of update events. The call to `EndUpdate` always concludes a call to `BeginUpdate`, undoing the results of the visible/update region manipulations of the latter.

### **doOSEvent**

`doOSEvent` first determines whether the Operating System event passed to it is a suspend/resume event or a mouse-moved event by examining bits 24-31 of the message field. It then switches according to that determination.

In the case of a suspend/resume event, a further examination of the message field establishes whether the event was a suspend event or a resume event. In the case of a resume event, the call to `SetCursor` ensures that the cursor will be set to the arrow cursor shape when the application comes to the foreground. (With regard to the call to `GetQDGlobalsArrow`, see the QuickDraw Globals and Accessor Functions sidebar.)

In the case of a mouse-moved event (which occurs when the mouse cursor has moved outside the region whose handle is currently being passed in `WaitNextEvent`'s `mouseRgn` parameter), `doAdjustCursor` is called to change the handle passed in the `mouseRgn` parameter according to the current location of the mouse.

### **drawEventString**

`drawEventString` is incidental to the demonstration. It simply prints text in the window indicating when the various types of events are received. `ScrollRect` scrolls the contents of the current graphics port within the rectangle specified in the first parameter. The second parameter specifies the number of pixels to be scrolled to the right and the third parameter specifies the number of pixels to scroll vertically, in this case 15 up.

### **doAdjustCursor**

`doAdjustCursor`'s primary purpose in this particular demonstration is to force the generation of mouse-moved events. The fact that it also changes the cursor shape simply reflects the fact that changing the cursor shape is usually the sole reason for generating mouse-moved events in the first place.

Basically, the function establishes two regions (the calls to `NewRgn`), one describing the content area of the window (in global coordinates) and the other everything outside that. The location of the cursor, in global coordinates, is then ascertained by the call to `GetGlobalMouse`. If the cursor is in the content area of the window (the I-Beam region), the cursor is set to the I-Beam shape and the handle to the I-Beam region is copied to the global variable passed in the



WaitNextEvent, of course, returns a mouse-moved event only when the cursor moves outside the “current” region, the handle to which is passed in the mouseRgn parameter of the WaitNextEvent call. Only one mouse-moved event, rather than a stream of mouse-moved events, will be generated when the cursor is moved outside the “current” region because

- The cursor and cursor adjustment aspects, as opposed to the region-swapping aspects, of the `doAdjustCursor` function are incidental to the demonstration. These aspects are addressed in more detail in Chapter 13.

[illegible]

regulation has been in place since 1991, and in the absence of the out-of-state  
the firm is not the only one that is subject to the regulation. The firm is not  
regulation is subject to the same regulation as the out-of-state firm.

regulation has been in place since 1991, and in the absence of the out-of-state  
the firm is not the only one that is subject to the regulation. The firm is not  
regulation is subject to the same regulation as the out-of-state firm.

regulation has been in place since 1991, and in the absence of the out-of-state  
the firm is not the only one that is subject to the regulation. The firm is not  
regulation is subject to the same regulation as the out-of-state firm.

regulation has been in place since 1991, and in the absence of the out-of-state  
the firm is not the only one that is subject to the regulation. The firm is not  
regulation is subject to the same regulation as the out-of-state firm.

regulation has been in place since 1991, and in the absence of the out-of-state  
the firm is not the only one that is subject to the regulation. The firm is not  
regulation is subject to the same regulation as the out-of-state firm.

Table 1. Summary of the Data	
Variable	Description
Y1	Dependent variable
Y2	Dependent variable
Y3	Dependent variable
Y4	Dependent variable
Y5	Dependent variable
Y6	Dependent variable
Y7	Dependent variable
Y8	Dependent variable
Y9	Dependent variable
Y10	Dependent variable
Y11	Dependent variable
Y12	Dependent variable
Y13	Dependent variable
Y14	Dependent variable
Y15	Dependent variable
Y16	Dependent variable
Y17	Dependent variable
Y18	Dependent variable
Y19	Dependent variable
Y20	Dependent variable
Y21	Dependent variable
Y22	Dependent variable
Y23	Dependent variable
Y24	Dependent variable
Y25	Dependent variable
Y26	Dependent variable
Y27	Dependent variable
Y28	Dependent variable
Y29	Dependent variable
Y30	Dependent variable
Y31	Dependent variable
Y32	Dependent variable
Y33	Dependent variable
Y34	Dependent variable
Y35	Dependent variable
Y36	Dependent variable
Y37	Dependent variable
Y38	Dependent variable
Y39	Dependent variable
Y40	Dependent variable
Y41	Dependent variable
Y42	Dependent variable
Y43	Dependent variable
Y44	Dependent variable
Y45	Dependent variable
Y46	Dependent variable
Y47	Dependent variable
Y48	Dependent variable
Y49	Dependent variable
Y50	Dependent variable
Y51	Dependent variable
Y52	Dependent variable
Y53	Dependent variable
Y54	Dependent variable
Y55	Dependent variable
Y56	Dependent variable
Y57	Dependent variable
Y58	Dependent variable
Y59	Dependent variable
Y60	Dependent variable
Y61	Dependent variable
Y62	Dependent variable
Y63	Dependent variable
Y64	Dependent variable
Y65	Dependent variable
Y66	Dependent variable
Y67	Dependent variable
Y68	Dependent variable
Y69	Dependent variable
Y70	Dependent variable
Y71	Dependent variable
Y72	Dependent variable
Y73	Dependent variable
Y74	Dependent variable
Y75	Dependent variable
Y76	Dependent variable
Y77	Dependent variable
Y78	Dependent variable
Y79	Dependent variable
Y80	Dependent variable
Y81	Dependent variable
Y82	Dependent variable
Y83	Dependent variable
Y84	Dependent variable
Y85	Dependent variable
Y86	Dependent variable
Y87	Dependent variable
Y88	Dependent variable
Y89	Dependent variable
Y90	Dependent variable
Y91	Dependent variable
Y92	Dependent variable
Y93	Dependent variable
Y94	Dependent variable
Y95	Dependent variable
Y96	Dependent variable
Y97	Dependent variable
Y98	Dependent variable
Y99	Dependent variable
Y100	Dependent variable

## IN THIS CHAPTER

- Introduction—Types of Menu 80
- Pull-Down Menu 80
- Hierarchical Menu 88
- Pop-Up Menu 88
- Menu Objects, Menu IDs and Item Numbers, Command IDs, and Menu Lists 89
- Creating Your Application's Menu 91
- Providing Help Balloons (Mac OS 8/9) 105
- Changing Menu Item Appearance 108
- Adding Items to a Menu 109
- Associating Data with Menu Items 112
- Handling Menu Choices 112
- Hiding and Showing the Menu Bar 116
- Accessing Menus From Alerts and Dialogs 116
- Main Menu Manager Constants, Data Types, and Functions 116
- Demonstration Program Menus1 Listing 120
- Demonstration Program Menus1 Comments 131
- Demonstration Program Menus2 Listing 136
- Demonstration Program Menus2 Comments 149

## Introduction—Types of Menus

A menu is a user interface element that allows the user to view, or choose from, a list of choices and commands provided by your application. There are basically three types of menus:

- **Pull-Down Menu.** A pull-down menu comprises a menu title, displayed in the menu bar, and one or more menu items.
- **Submenus.** A submenu is a menu that is attached to another menu. A menu to which a submenu is attached is referred to as a **hierarchical menu**.
- **Pop-Up Menu.** A pop-up menu is a menu that does not appear in the menu bar but rather appears on another part of the screen.

## Pull-Down Menu

### Menu Definition Functions and Menu Bar Definition Functions

The Menu Manager uses the following to display, and to perform basic operations on, menus and the menu bar:

- **Menu Definition Function.** When you define a menu, you must specify the required menu definition function (MDEF). The Menu Manager uses that MDEF to draw the menu items in a menu, determine which item the user chose, and so on. An MDEF thus determines the look and behavior of menus.
- **Menu Bar Definition Function.** The Menu Manager uses the menu bar definition function (MBDF) to draw and clear the menu bar, determine whether the cursor is currently within the menu bar or any currently displayed menu, highlight menu titles, and so on. A menu bar definition function thus determines the look and behavior of the menu bar.

### Standard Menu and Menu Bar Definition Functions

The system software provides a standard MDEF and a standard MBDF. The standard MDEF is the 'MDEF' resource with a resource ID of 63. The standard MBDF is the 'MBDF' resource with a resource ID of 63.

Ordinarily, your application will specify the standard definition functions; however, as with most other elements of the Macintosh user interface, the option is available to write your own custom definition function if you need to provide features not available in the standard definition functions.



## The Menu Bar and Menus

### The Menu Bar

The menu bar extends across the top of the screen and is high enough to display menu titles in the height of the large system font (Mac OS 8/9) or system font (Mac OS X).

Generally, the menu bar should always be visible. If you want to hide the menu bar for some reason, you should provide a method (for example, a keyboard equivalent) to allow the user to make the menu bar reappear.

### The 'MBAR' Resource

Each application has its own menu bar, which is defined by an 'MBAR' resource. This resource lists the order and resource ID of each menu appearing in your menu bar. Your application's 'MBAR' resource should be defined such that the Mac OS 8/9 Apple menu or Mac OS X Application menu (see below) is the first menu in the menu bar, with the File menu being the next. For Mac OS 8/9, the Help menu and the Mac OS 8/9 Application menu do not need to be defined in the 'MBAR' resource, because the Menu Manager automatically adds them to the menu bar when the application calls `GetNewMBar`, provided that your menu bar includes the Apple menu.

## Menus

All Macintosh applications should ordinarily provide the Mac OS 8/9 Apple menu or Mac OS X Application menu, a File menu, and a Window menu (see Chapter 16). If your application is not document-oriented, the File menu may be renamed to something more appropriate.

Your application can disable any menu, which causes the Menu Manager to dim that menu's title and all associated menu items. The menu items can also be disabled individually. Your application should specify whether menu items are enabled or disabled when it first defines and creates a menu and can enable or disable items at any time thereafter.

### The 'MENU' Resource

For each menu, you define the menu title and the individual characteristics of its menu items in a 'MENU' resource.

### The 'xmnu' Resource

For each menu, you may also define an 'xmnu' (extended menu) resource. The 'xmnu' resource is, in effect, an extension of the 'MENU' resource required to provide for additional menu features. Note that you do not need to provide this resource if you do not require these additional features. An 'xmnu' resource must have the same ID as the 'MENU' resource it extends.

## Menu Items

A menu item can contain text or a **divider**. On Mac OS 8/9 the divider is a line extending the full width of the menu. On Mac OS X it is simply an empty space, like a menu item with no text. Each menu item, other than a divider, can have a number of characteristics as follows:

- An icon, small icon, reduced icon, color icon, or an icon from an icon family to the left of the menu item's text.

### NOTE

The various icon types are described in Chapter 13.

- A checkmark or other **marking character** indicating the status of the menu item or the mode it controls.
- The symbols for the item's keyboard equivalent. (An item that has a keyboard equivalent cannot have a submenu, a small icon or a reduced icon.)
- A triangular indicator to the right of a menu item's text to indicate that the item has a submenu. (An item that has a submenu cannot have a keyboard equivalent, a small icon or a reduced icon.)
- A font style (bold, italic, and so on) for the menu item's text.
- The text of the menu item.
- The ellipsis character (...) as the last character in the text of the menu item, indicating that the application will display a dialog requesting more information from the user before executing the command. (The ellipsis character should not be used in menu items that display informational dialogs or a confirmational alert.)
- A dimmed appearance when the application disables the item. (When the menu title is dimmed, all menu items in that menu are also dimmed.)

## Groups of Menu Items

Where appropriate, menu items should be grouped, with each group separated by a divider. For example, a menu can contain commands that perform actions and commands that set attributes. The action commands that are logically related should be grouped, as should attribute commands that are interdependent. The attribute commands that are mutually exclusive, and those that form accumulating attributes (for example, Bold, Italic and Underline), should also be grouped.



## Keyboard Equivalents for Menu Commands

The Menu Manager provides support for **keyboard equivalents**. Your application can detect a keyboard equivalent by examining the `modifiers` field of the event structure, first determining whether the Command key was pressed at the time of the event. If a keyboard equivalent is detected, your application typically calls `MenuEvent`, which maps the keyboard equivalent character contained in the specified event structure to its corresponding menu and menu item and returns the menu ID and the chosen menu item.

**NOTE**

A **keyboard equivalent** is any combination of the Command key, optionally one or more modifier keys (Shift, Option, Control), and another key. A **Command-key equivalent** such as Command-C is thus, by definition, also a keyboard equivalent.

### Reserved Command-Key Equivalents

Apple reserves the following Command-key equivalents, which should be used in the File and Edit menus of your application:

<i>Keys</i>	<i>Command</i>	<i>Menu</i>
Command-A	Select All	Edit
Command-C	Copy	Edit
Command-N	New	File
Command-H	Hide <appname>	Application (Mac OS X)
Command-M	Minimize Window	Window (Mac OS X)
Command-O	Open...	File
Command-P	Print...	File
Command-Q	Quit	File (Mac OS 8/9) Application (Mac OS X)
Command-S	Save	File
Command-V	Paste	Edit
Command-W	Close	File
Command-X	Cut	Edit
Command-Z	Undo	Edit

Other common keyboard equivalents are

<i>Keys</i>	<i>Command</i>	<i>Menu</i>
Command-B	Bold	Style
Command-F	Find	File
Command-G	Find Again	File
Command-I	Italic	Style
Command-T	Plain Text	Style
Command-U	Underline	Style

## The Mac OS 8/9 Apple Menu and Mac OS X Application Menu

On Mac OS 8/9, the Mac OS 8/9 Apple Menu is the first menu in your application. On Mac OS X, the Mac OS X Application Menu (see Fig 1) is the first menu.

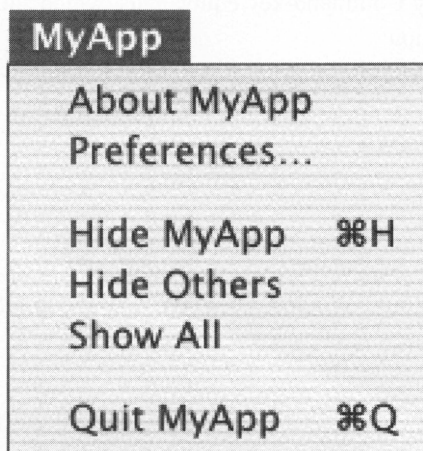


FIG 1 - MAC OS X APPLICATION MENU

Typically, applications provide an About command as the first menu item in the Apple (Mac OS 8/9) and Mac OS X Application menus. On Mac OS 8/9, the remaining items are controlled by the contents of the Apple Menu Items folder in the System folder. On Mac OS X, the remaining items are the default items automatically included in the system-created Mac OS X Application menu. Mac OS X Application menu items are general to the application, that is, they are items that are not specific to a document or other window.

To create your application's Mac OS 8/9 Apple menu for Mac OS 8/9, you simply define the Apple menu title and the characteristics of your application's About command in a 'MENU' resource. When your application is run on Mac OS 8/9, the contents of the Apple Menu Items folder are automatically added to the Apple menu.

The Apple menu 'MENU' resource will also cause the About command to be inserted in the Mac OS X Application menu when the application is run on Mac OS X.

When the user chooses the About command on Mac OS 8/9, your application should display a dialog or an alert containing your application's name, version number, copyright information, any other information as required. On Mac OS X, your application should display a modeless dialog containing the application's version and copyright information, as prescribed in Aqua Human Interface Guidelines.

## The File Menu

The standard File menu contains commands related to document management plus, on Mac OS 8/9, the Quit command. (On Mac OS X, the Quit command is located in the Application menu (refer to Fig 1).) The standard commands should be supported by your application where appropriate (see Fig 2). Any other commands added to the menu should pertain to the management of documents. The actions your application should take when File menu commands are chosen are detailed in Chapter 15 and Chapter 18.

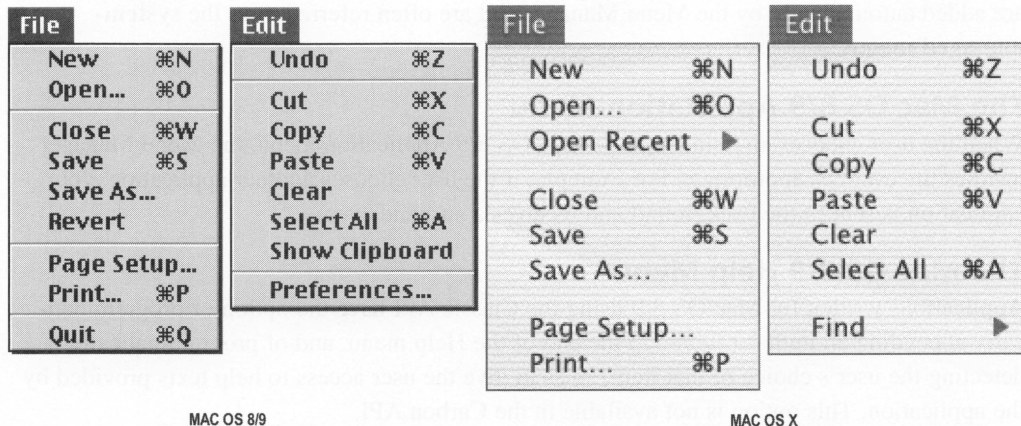


FIG 2 - THE STANDARD FILE AND EDIT MENUS

## The Edit Menu

The standard Edit menu provides commands related to the editing of a document's contents, to copying data between different applications using the Clipboard and, on Mac OS 8/9, to show-

ing and hiding the Clipboard (refer to Fig 2). For Mac OS 8/9 only, the standard Edit menu also standardizes the location of the Preferences... command, which, when chosen, should invoke a dialog that enables the user to set application-specific preferences. (On Mac OS X, the Preferences... command is located in the Mac OS X Application menu.)

#### NOTE

The implementation of Preferences commands is demonstrated at the demonstration program in Chapter 19.

All Macintosh applications which support text entry, including text entry in edit text items in dialogs, should include the standard editing commands (Undo, Cut, Copy, Paste and Clear). An additional word or phrase should be added to Undo to clarify exactly what action your application will reverse.

Other commands may be added if they are related to editing or changing the contents of your application's documents.

## The Mac OS 8/9 System-Managed Menus

On Mac OS 8/9, two menus, namely the Mac OS 8/9 Application menu and the Help menu, are added automatically by the Menu Manager and are often referred to as the **system-managed menus**.

### The Mac OS 8/9 Application Menu

When the user chooses an item from the Mac OS 8/9 Application menu, the Menu Manager handles the event as appropriate. For example, if the user chooses another application, your application is sent to the background and receives a suspend event.

### The Mac OS 8/9 Help Menu

Applications written for Mac OS 8/9 using the Classic API have the option of programmatically appending an item (or items) to the end of the Help menu, and of programmatically detecting the user's choice of that item, so as to give the user access to help texts provided by the application. This option is not available in the Carbon API.

Carbon applications may use **Apple Help**, which was introduced with Mac OS 8.6, to provide application help. Apple Help documentation and tools are included in an Apple Help Software Development Kit (SDK), which is available at <http://developer.apple.com/sdk>. The documentation describes how to create an Apple Guide file, which, when located in the same folder as your application, will cause the system to install a help menu item (or items) in the Help menu. The menu at the left in Fig 3 show the Help menu as it normally appears. The menus at the right at Fig 3 show the Help menu as it appears when the Apple Guide file is present.

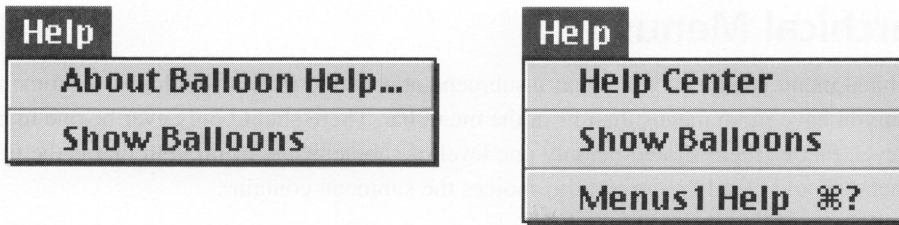


FIG 3 - THE MAC OS 8/9 HELP MENU - EFFECT OF THE APPLE GUIDE FILE

## Mac OS Help Menus

For Mac OS X, your application must itself create the Help menu (using the function `HMGetHelpMenu`), insert the required item, or items, in that menu, and respond to the user choosing items in the menu.

## Font Menus

If your application has a Font menu, you should list in that menu the names of all currently available fonts (that is, all those residing in the Fonts folder in the System folder). Fonts may be added to the Font menu using `AppendResMenu` or `InsertResMenu`. However, a better alternative is to use the relatively new Menu Manager function `CreateStandardFontMenu` to build either a hierarchical or non-hierarchical Font menu. (A hierarchical Font menu is one in which the styles available in each font family (regular, bold, italic, and so on) appear in a submenu attached to the menu item containing the font family name.)

To indicate which font is currently in use in a non-hierarchical Font menu, your application should add a checkmark to the left of the font's name in the Font menu. If the current selection contains more than one font, a dash should be placed next to the name of each font the selection contains. When the user starts entering text at the insertion point, your application should display text in the current font.

To indicate which font is currently in use in a hierarchical Font menu, your application should place a checkmark next to the font in the submenu and a dash next to the menu item to which the submenu is attached.

## Font Attributes

Separate menus should be used to accommodate lists of font attributes such as styles and sizes.

## WYSIWYG Font Menus

The function `SetMenuItemFontID` allows you to easily set up a Font menu with each item being drawn in the actual font.



## Hierarchical Menus

A hierarchical menu is a menu which has a submenu attached to it. You should use a submenu only when you have more menus than fit in the menu bar. There should only ever be one hierarchical level, that is, there should be only one level of submenus. A menu item that is the title of a submenu should clearly represent the choices the submenu contains.

Hierarchical menus work best for providing a submenu of attributes.

## Pop-Up Menus

Pop-up menus work well when your application needs to present several choices to the user and it is acceptable to hide these choices until the menu is opened. (Other methods of displaying choices are checkboxes and radio buttons.) Pop-up menus should not be used for multiple choice lists or as a way to provide more commands. They should contain attributes rather than actions; accordingly, Command-key equivalents should not be used in pop-up menus.

The standard pop-up menu is actually implemented as a **control**, specifically, the **pop-up menu button control**. Its appearance and behavior is thus determined by a pop-up menu button control definition function (see Fig 4).

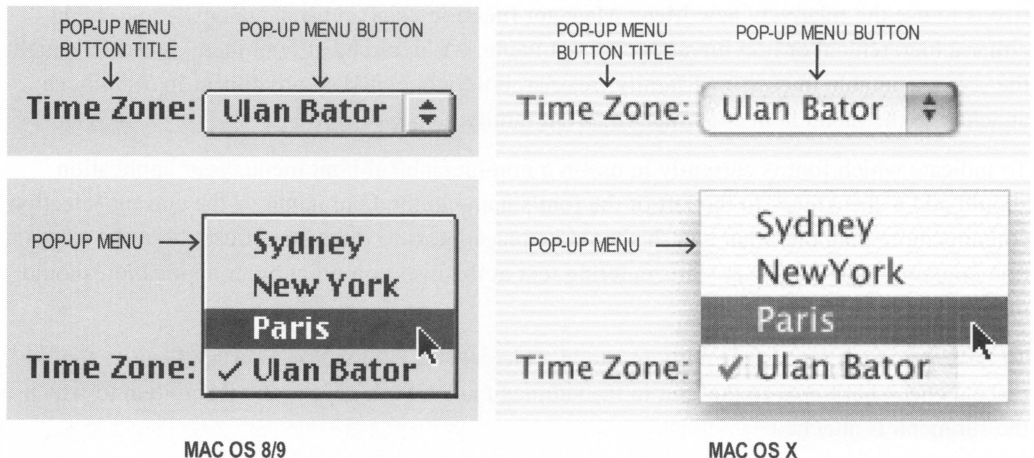


FIG 4 - POP-UP MENU BUTTON (EXAMPLE)

Because pop-up menus are implemented as controls, they are addressed at Chapter 7. Further information in this chapter will be limited to the provision of the 'MENU' resource required by the pop-up menu button control.



# Menu Objects, Menu IDs and Item Numbers, Command IDs, and Menu Lists

## The Menu Object

The Menu Manager maintains information about individual menus in opaque data structures known as **menu objects**. The data type `MenuHandle` is defined as a pointer to a menu object:

```
typedef struct OpaqueMenuHandle* MenuHandle;
```

Note that the data type `MenuHandle` is equivalent to the newer data type `MenuRef`:

```
typedef MenuHandle MenuRef;
```

### Carbon Note

A major change introduced in Carbon is that some commonly used data structures are now **opaque**, meaning that their internal structure is hidden to applications. Directly referencing fields within these structures is no longer possible, and special new **accessor functions** must be used instead.

As an example, the Classic API equivalent of the menu object is the `MenuInfo` structure, which is defined as follows:

```
struct MenuInfo
{
    MenuID    menuID;
    short     menuWidth;
    short     menuHeight;
    Handle     menuProc;
    long      enableFlags;
    Str255     menuData;
};
typedef struct MenuInfo MenuInfo;
typedef MenuInfo *MenuPtr;
typedef MenuPtr *MenuHandle;
```

In the Classic API, your application can determine the menu width by directly accessing the `menuWidth` field like this:

```
MenuHandle menuHdl;
SInt16      width;

menuHdl = GetMenuHandle(mFile); // Get handle to MenuInfo structure.
width   = (**menuHdl).menuWidth;
```

In Carbon, you must use the accessor function `GetMenuWidth` to obtain the menu width from a menu object:

```
MenuRef menuRef;
SInt16 width;

menuRef = GetMenuRef(mFile);    // Get reference to menu object.
width   = GetMenuWidth(menuRef);
```

The following accessor functions are provided to access the information in menu objects:

<i>Function</i>	<i>Description</i>
<code>GetMenuID</code>	Gets the menu ID of the specified menu.
<code>SetMenuID</code>	Sets the menu ID of the specified menu.
<code>GetMenuWidth</code>	Gets the horizontal dimensions, in pixels, of the specified menu.
<code>SetMenuWidth</code>	Sets the horizontal dimensions, in pixels, of the specified menu.
<code>GetMenuHeight</code>	Gets the vertical dimensions, in pixels, of the specified menu.
<code>SetMenuHeight</code>	Sets the vertical dimensions, in pixels, of the specified menu.
<code>GetMenuTitle</code>	Gets the title of the specified menu.
<code>SetMenuTitle</code>	Sets the title of the specified menu.
<code>SetMenuTitleWithCFString</code>	
<code>GetMenuDefinition</code>	Gets a pointer to a custom menu definition function that has already been associated with the menu. (There is no way to get a pointer to the system menu definition function.)
<code>SetMenuDefinition</code>	Sends a dispose message to the current menu definition and an init message to the new definition.

You typically specify most of the information in a menu object in a 'MENU' resource. When you create a menu, the Menu Manager creates a menu object for the menu and returns a reference to that object. The Menu Manager automatically updates the menu object when you make any changes to the menu programmatically.

## Menu IDs and Item Numbers

To refer to a menu, you usually use either the menu's ID or the reference to the menu's menu object. Accordingly, you must assign a **menu ID** to each menu in your application as follows:

- Pull-down menus must use a menu ID greater than 0.
- Submenus of an application may use a menu ID in the range 1 to 32767.

To refer to a menu item, you use the item's **item number**. Item numbers in a menu start at 1.

## Command IDs

The **command ID**, a unique value that you set to identify a menu item, is an alternative way of referring to a specific menu item in an application's menus.

## The Menu List

The **menu list**, a structure private to the Menu Manager, contains references to the menu objects of one or more menus (although a menu list can, in fact, be empty). The end of a menu list contains references to the menu objects of submenus and pop-up menus, if any, the phrase "submenu portion of the menu list" referring to this portion of the list.

At application launch, the Menu Manager creates the menu list. The menu list is initially empty but changes as your application adds menus to it or removes menus from it programmatically.

## Creating Your Application's Menus

### 'MBAR', 'MENU', and 'xmnu' Resources

As stated in Chapter 1, you can provide a textual, formal description of resources in a file and then use a resource compiler such as Rez to compile the description into a resource, or you can create resource descriptions using a resource editor such as Resorcerer. This book assumes the use of Resorcerer.

When creating resources using Resorcerer, it is advisable that you refer to a diagram and description of the structure of the resource and relate that to the various items in the Resorcerer editing windows. Accordingly, the following describes the structure of those resources associated with the creation of menus.

### Structure of a Compiled 'MBAR' Resource

Fig 5 shows the structure of a compiled 'MBAR' resource. The number of menu resource IDs should match the number of menus declared in the first two bytes.

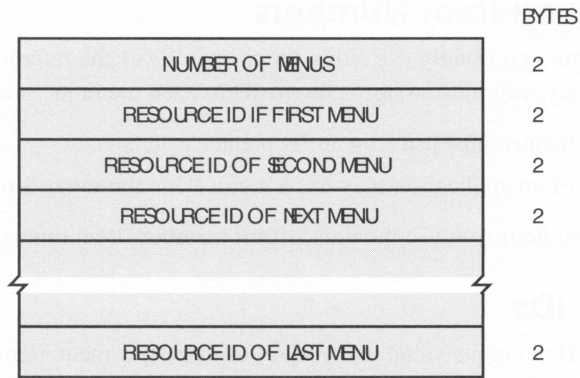


FIG5 - STRUCTURE OF A COMPILED 'MBAR' RESOURCE

### Structure of a Compiled 'MENU' Resource

Fig 6 shows the structure of a compiled 'MENU' resource (and its variable length data) and how it "feeds" the menu object.

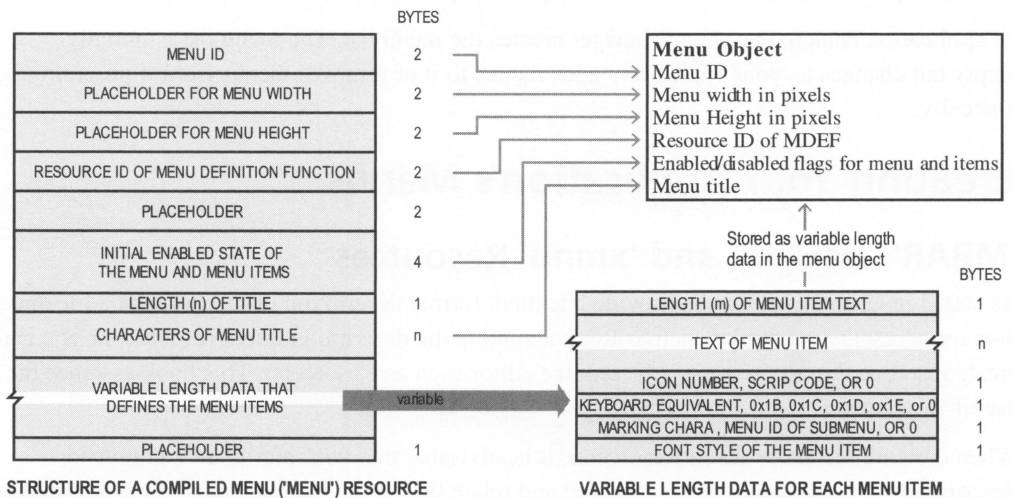


FIG 6 - STRUCTURE OF A COMPILED MENU ('MENU') RESOURCE AND ITS VARIABLE LENGTH DATA

The following describes the main fields of the 'MENU' resource:

Field	Description
MENU ID	<p>The menu's unique identification number. Note that the number assigned to the menu ID and the resource ID do not have to be identical, though it is advisable that these numbers be the same.</p> <p>A menu ID from 1 to 235 indicates a menu (or submenu) of an application. Apple reserves the menu ID of 0.</p>
PLACEHOLDER FOR MENU WIDTH PLACEHOLDER FOR MENU HEIGHT	<p>After reading in the resource data, the Menu Manager requests the menu's MDEF to calculate the width and height of the menu and store these values in the menu object.</p>
RESOURCE ID OF MENU DEFINITION FUNCTION	<p>If the integer 63 appears here, the standard MDEF will be used. The MDEF is read in after the menu's resource data is read in. The Menu Manager stores a handle to the MDEF in the menu object.</p>
INITIAL ENABLED STATE OF THE MENU AND MENU ITEMS	<p>A value whose bits indicate if the corresponding menu item is enabled or disabled, with bit 0 indicating whether the menu as a whole is enabled or disabled.</p>
VARIABLE LENGTH DATA THAT DEFINES THE MENU ITEMS	<p>The Menu Manager stores the variable length data for each menu item at the end of the menu object (see Fig 6).</p>

The following describes the main fields of the variable length data for each menu item. Note that various alternatives apply to the icon number, keyboard equivalent, and marking character fields. For example, a menu item can have a keyboard equivalent or a submenu, but not both.



<i>Field</i>	<i>Description</i>
ICON NUMBER, SCRIPTCODE, OR 0	<p><b>ICON NUMBER</b></p> <p>A number from 1 to 255 (or from 1 to 254 for small or reduced icons).</p> <p>If the menu item specifies an icon, you must provide a 'cicn' (color icon) or 'ICON' resource with a resource ID equal to the icon number plus 256. If you want an 'ICON' resource to be reduced to the size of a small icon ('SICN'), or if you want the size of a 'cicn' resource reduced by half, assign the value 0x1D to the keyboard equivalent field. If you want a 'SICN' resource, assign the value 0x1E.</p> <p>The Menu Manager looks first for a 'cicn' resource with the calculated resource ID. In the Carbon era, color icons are much to be preferred.</p> <p><b>SCRIPTCODE</b> (Not used when the 'MENU' resource is extended with an 'xmnu' resource)</p> <p>Specify the script code here if you want the item's text to be drawn in a script other than the system script, and also provide 0x1C in the keyboard equivalent field.</p> <p><i>When the 'MENU' resource is extended by an 'xmnu' resource, the script code should be set in the text encoding field of the 'xmnu' resource.</i></p> <p>0</p> <p>Specifies that the menu item does not contain an icon and uses the system script.</p>
KEYBOARD EQUIVALENT, 0X1B, 0X1C,	<p><b>KEYBOARD EQUIVALENT</b> 0X1D, 0X1E, OR 0</p> <p>Specified as a one-byte character and, actually, a Command-key equivalent only.</p> <p>The Command-key equivalent can be extended with modifier key (Shift, Option, Control) constants in the modifier keys field of the extended menu ('xmnu') resource (see below).</p>



Field	Description
	0x1B
	Specifies that the menu item has a submenu. (The menu ID of the submenu should be assigned to the marking character field (see below).)
	0x1C (Not used when the 'MENU' resource is extended with an 'xmnu' resource)
	Specifies that the item uses a script other than the system script. (The script code should be assigned to the icon number field (see above).)
	<i>When the 'MENU' resource is extended by an 'xmnu' resource, the script code should be set in the text encoding field of the 'xmnu' resource.</i>
	0x1D
	For menu items containing icons, causes 'ICON' resources to be reduced to the size of a small icon, or 'cicn' resources to be reduced by half.
	0x1E
	Specifies that you want the Menu Manager to use a small icon ('SICN') resource for the item's icon. (The small icon's resource ID should be assigned to the icon number field (see above).)
	0
	Specifies that the menu item has neither a keyboard equivalent nor a submenu and uses the system script.
MARKING CHARACTER, MENU ID OF SUBMENU, OR 0	MARKING CHARACTER SUBMENU, OR 0
	Special characters, such as the checkmark and diamond characters are available to indicate the marks associated with a menu item.

<i>Field</i>	<i>Description</i>
	<b>MENU ID OF SUBMENU</b> Submenus of an application must have menu IDs from 1 to 235. Submenus of a driver must have menu IDs from 236 to 255.
	0 Specifies that the item has neither a mark nor a submenu.
<b>FONT STYLE OF THE MENU ITEM</b>	Specifies whether the font style of the menu item should be plain, or any combination of bold, italic, outline, and shadow.

**NOTE**

As the user traverses menu items, if an item has a submenu, the `MenuSelect` function looks in the submenu portion of the menu list for the submenu. It then searches for a menu with a defined menu ID that matches the menu ID specified by the hierarchical menu item. If it finds a match, it attaches the submenu to the menu item.

## Structure of a Compiled 'xmenu' Resource

The 'xmenu' resource provides for the additional features, for example, support for extended modifier keys, command IDs, and so on. Fig 7 shows the structure of a compiled 'xmenu' resource and an individual menu item entry in that resource.

The following describes the fields of a compiled 'xmenu' resource:

<i>Field</i>	<i>Description</i>
<b>VERSION NUMBER</b>	Version of the resource.
<b>NUMBER OF ENTRIES</b>	Number of entries (extended menu item structures) in the resource.
<b>FIRST EXTENDED MENU ENTRY</b>	A number of extended menu item structures (see below).
...	
<b>LAST EXTENDED MENU ENTRY</b>	

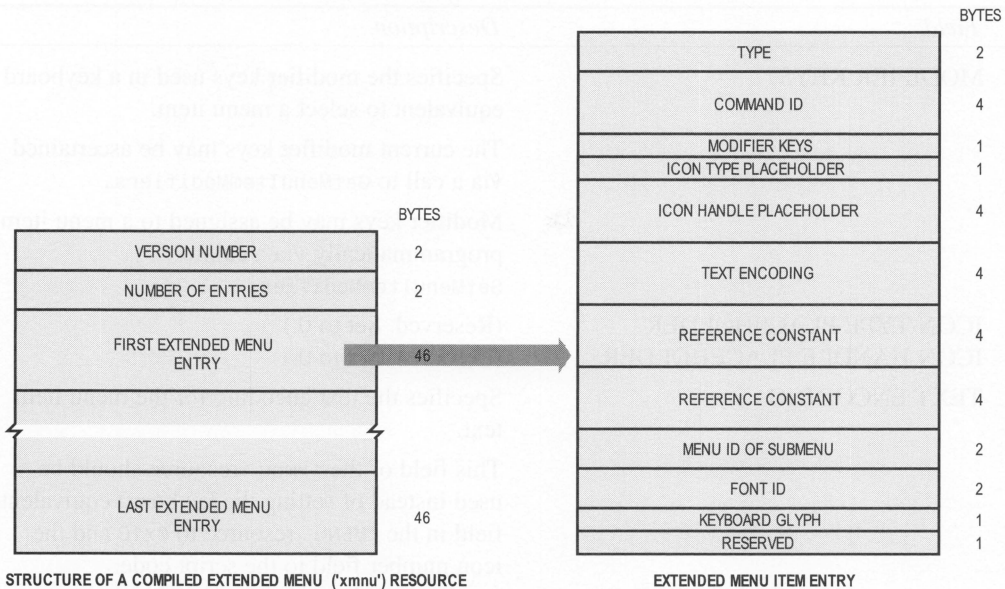


FIG 7 - STRUCTURE OF A COMPILED EXTENDED MENU ('xmenu') RESOURCE AND AN EXTENDED MENU ITEM ENTRY

Each entry in a 'xmenu' resource corresponds to a menu item. The following describes the main fields of an extended menu item entry.

Field	Description
TYPE	Specifies whether there is extended information for the item. 1 indicates that there is extended information for the item, causing the rest of the entry to be read in. 0 indicates that there is no information for the item, causing the Menu Manager to skip the rest of the entry.
COMMAND ID	<p>A unique value used to identify the menu item (as opposed to referring to the item using the menu ID and item number).</p> <p>This value may be ascertained via a call to <code>GetMenuItemCommandID</code>.</p> <p>A command ID may be assigned to a menu item programmatically via a call to <code>SetMenuItemCommandID</code>.</p>

<i>Field</i>	<i>Description</i>
MODIFIER KEYS	<p>Specifies the modifier keys used in a keyboard equivalent to select a menu item.</p> <p>The current modifier keys may be ascertained via a call to <code>GetMenuItemModifiers</code>.</p> <p>Modifier keys may be assigned to a menu item programmatically via a call to <code>SetMenuItemModifiers</code>.</p>
ICON TYPE PLACEHOLDER	(Reserved. Set to 0.)
ICON HANDLE PLACEHOLDER	(Reserved. Set to 0.)
TEXT ENCODING	<p>Specifies the text encoding for the menu item text.</p> <p>This field of the 'xmnu' resource should be used instead of setting the keyboard equivalent field in the 'MENU' resource to 0x1C and the icon number field to the script code.</p> <p>If you want to use the system script, assign -1. If you want to use the current script, assign -2.</p> <p>The current text encoding may be ascertained via a call to <code>GetMenuItemTextEncoding</code>.</p> <p>Text encoding may be assigned to a menu item programmatically via a call to <code>SetMenuItemTextEncoding</code>.</p>
REFERENCE CONSTANT	<p>Any value an application wants to store.</p> <p>The current value may be ascertained via a call to <code>GetMenuItemRefCon</code>.</p> <p>Reference constants may be assigned to a menu item programmatically via a call to <code>SetMenuItemRefCon</code>.</p>
REFERENCE CONSTANT	<p>Any additional value an application wants to store.</p> <p>The getter and setter functions relating to this second reference constant are not available in Carbon. If you wish to associate data with a menu item you should use the functions which are available for that purpose (see “Associating Data With Menu Items”).</p>

Field	Description
MENU ID OF SUBMENU	<p>A value between 1 and 235, identifying the submenu.</p> <p>The current submenu ID may be ascertained via a call to <code>GetMenuItemHierarchicalID</code>.</p> <p>The menu ID of a submenu may be assigned to a menu item programmatically via a call to <code>SetMenuItemHierarchicalID</code>. This, in effect, attaches a submenu to the menu item.</p>
FONT ID	<p>The ID of the font family. If this value is 0, then the large system font ID (Mac OS 8/9) or system font (Mac OS X) is used.</p> <p>The current font ID may be ascertained via a call to <code>GetMenuItemFontID</code>.</p> <p>The font ID of a menu item may be set programmatically via a call to <code>SetMenuItemFontID</code>.</p>
KEYBOARD GLYPH	<p>A symbol representing a menu item's modifier key.</p> <p>The current keyboard glyph may be ascertained via a call to <code>GetMenuItemGlyph</code>.</p> <p>If the value in this field is zero, the keyboard glyph uses the keyboard font. (A glyph is a visual representation of a character.) You can override the character code to be displayed with a substitute glyph by assigning a non-zero value to this field.</p> <p>The keyboard glyph of a menu item may be set programmatically via a call to <code>SetMenuItemKeyGlyph</code>.</p>

The information in an 'xmnu' resource is set for specified menu items; it is not necessary to create an extended menu entry for all menu items in a menu.

It is not necessary to provide 'xmnu' resources if your application's menus do not require the additional features provided by this resource.

## Creating 'MBAR', 'MENU', and 'xmnu' Resources Using Resorcerer

As previously stated, when creating resources using Resorcerer, it is advisable that you refer to a diagram and description of the structure of the resource and relate that to the various items in the Resorcerer editing windows. The following assumes that approach.

### Creating 'MBAR' Resources

Fig 8 shows an 'MBAR' resource containing seven menus being created with Resorcerer. The first three entries would be, respectively, the Apple, File, and Edit menus.

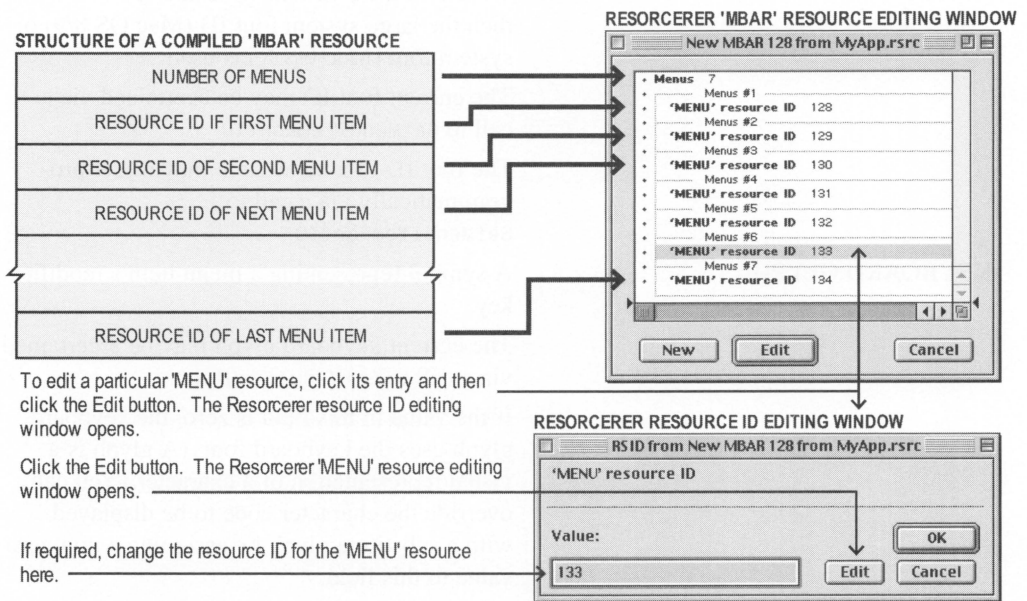


FIG 8 - CREATING AN 'MBAR' RESOURCE USING RESORCERER

### Creating 'MENU' Resources

Fig 9 shows an imaginary View menu with the Full Screen menu item being edited. This menu item has been assigned a keyboard equivalent (more specifically, a Command-key equivalent); accordingly, the Key Equiv: radio button has been clicked and the character F has been entered as the Command-key equivalent. The menu item has also been assigned a marking character (a checkmark).



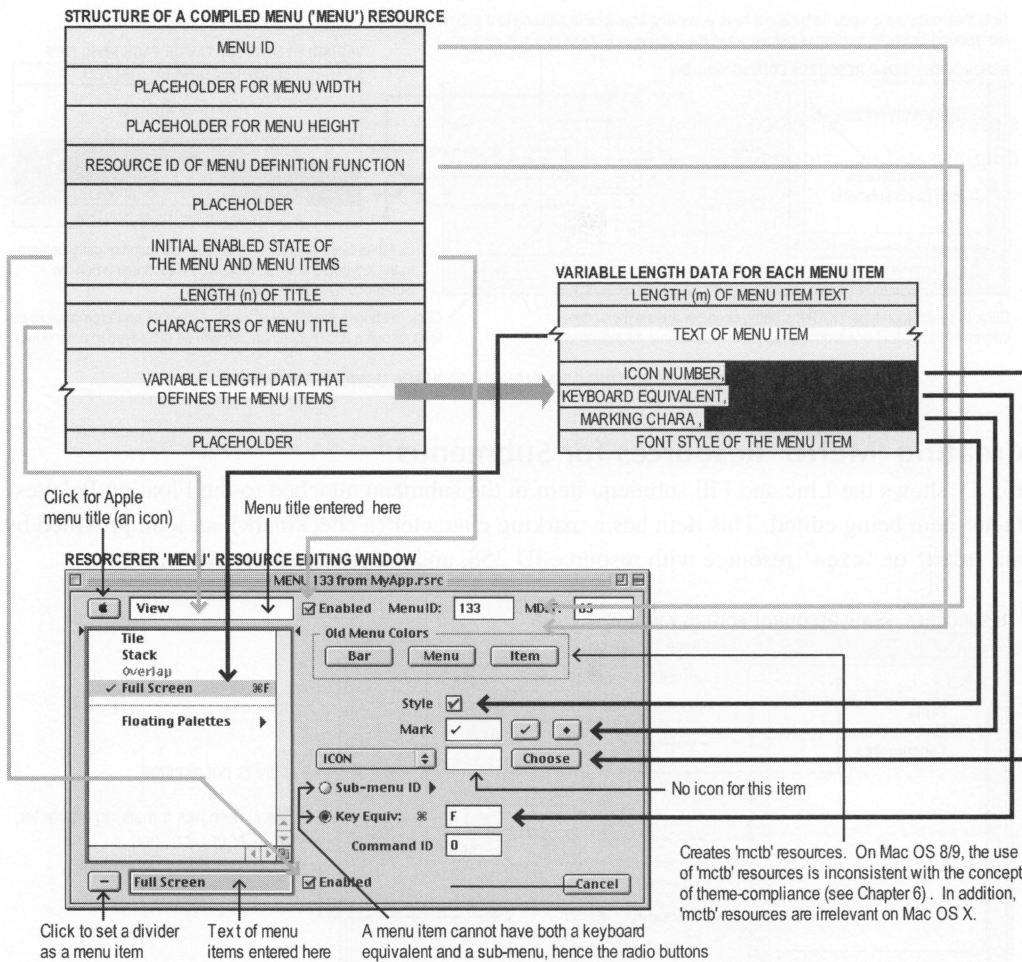


FIG 9 - EDITING A 'MENU' RESOURCE USING RESORCER

Fig 10 shows the same View menu with the Floating Palettes menu item being edited. This item has a submenu; accordingly, the Sub-menu ID radio button has been clicked and the resource ID of the submenu's 'MENU' resource has been entered. The item also has an icon provided by a 'CICN' or 'cicn' resource with a resource ID of 257.

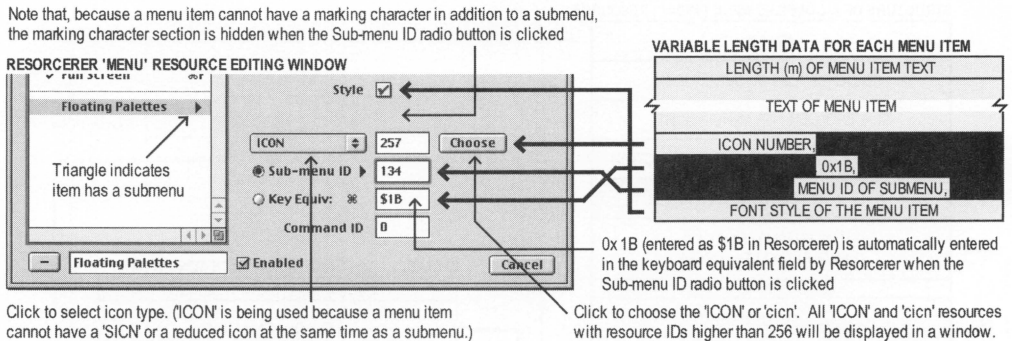


FIG 10 - FURTHER EDITING OF A 'MENU' RESOURCE USING RESORCERER

## Creating 'MENU' Resources for Submenus

Fig 11 shows the Line and Fill submenu item in the submenu attached to the Floating Palettes menu item being edited. This item has a marking character (a checkmark), an icon provided by an 'ICON' or 'cicon' resource with resource ID 258, and a Command-key equivalent.

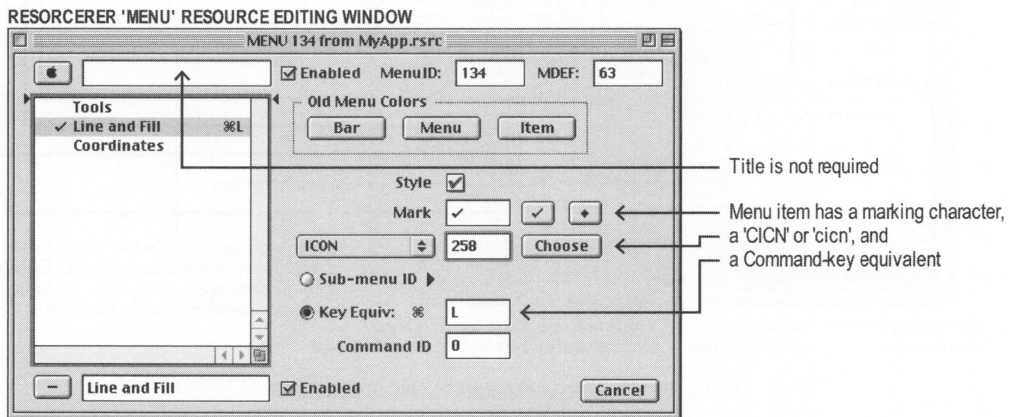


FIG 11 - EDITING A 'MENU' RESOURCE FOR A SUBMENU USING RESORCERER

## Creating 'xmnu' Resources

Fig 12 shows an 'xmnu' resource being created using Resorcerer. This 'xmnu' resource extends the 'MENU' resource with resource ID 133 (the View menu, above). Menu item 4 has been assigned a command ID, and the Command-key equivalent assigned to this item in the 'MENU' resource (Command-F) has been extended to the keyboard equivalent Command-Shift-F by specifying the Shift key as an extended modifier.

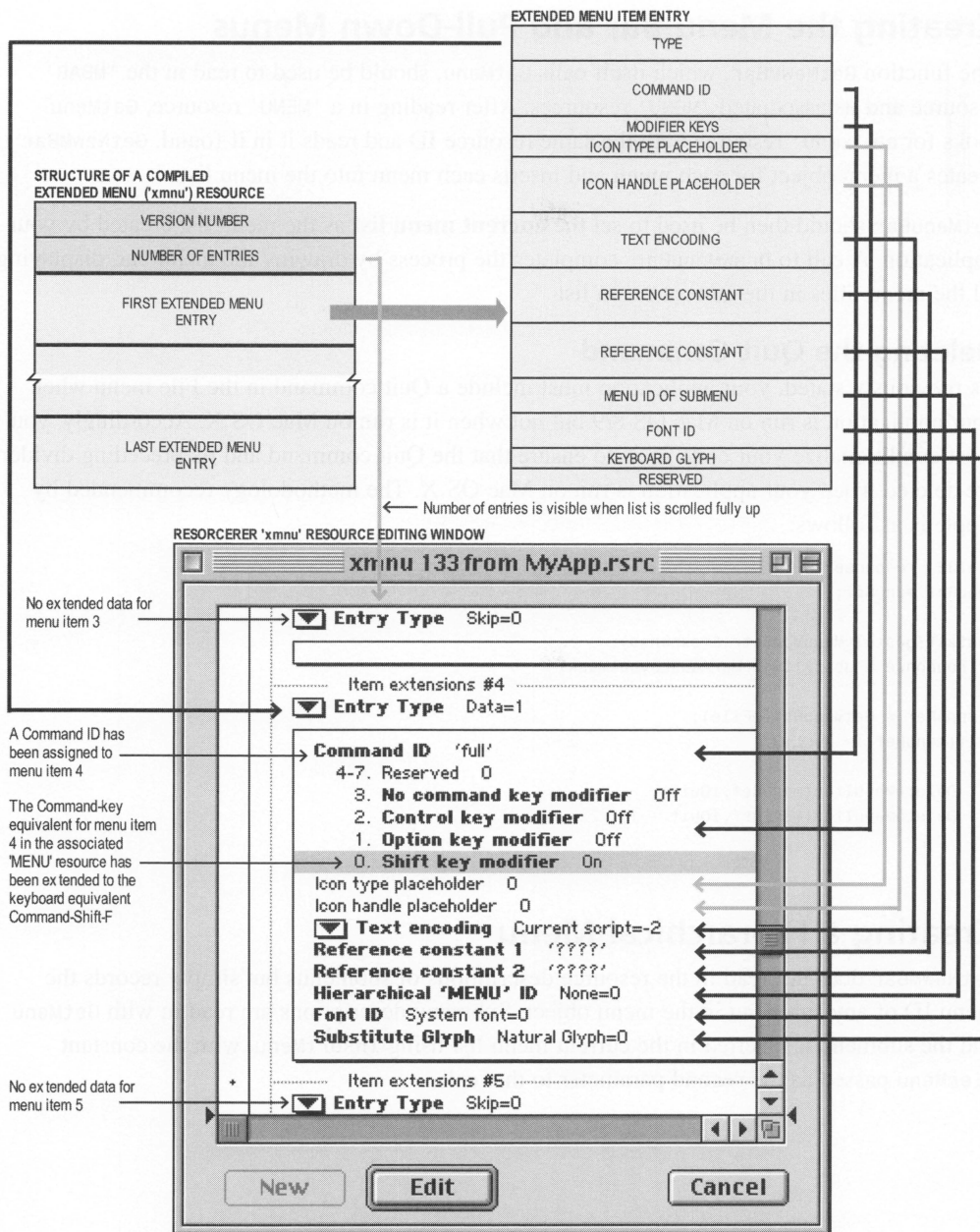


FIG 12 - CREATING AN 'xmenu' RESOURCE USING RESORCERER

## Creating the Menu Bar and Pull-Down Menus

The function `GetNewMBar`, which itself calls `GetMenu`, should be used to read in the 'MBAR' resource and its associated 'MENU' resources. After reading in a 'MENU' resource, `GetMenu` looks for an 'xmnu' resource with the same resource ID and reads it in if found. `GetNewMBar` creates a menu object for each menu and inserts each menu into the menu list.

`SetMenuBar` should then be used to set the **current menu list** as the menu list created by your application. A call to `DrawMenuBar` completes the process by drawing the menu bar, displaying all the menu titles in the current menu list.

## Deleting the Quit Command

As previously stated, your application must include a Quit command in the File menu when your application is run on Mac OS 8/9 but not when it is run on Mac OS X. Accordingly, you must conditionalize your code so as to ensure that the Quit command and its preceding divider are deleted when your application is run on Mac OS X. The methodology recommended by Apple is as follows:

```
SInt32 response;
MenuRef menuRef;

Gestalt(gestaltMenuMgrAttr,&response);
if(response & gestaltMenuMgrAquaLayoutMask)
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
    {
        DeleteMenuItem(menuRef,iQuit);
        DeleteMenuItem(menuRef,iQuit - 1);
    }
}
```

## Creating a Hierarchical Menu

`GetNewMBar` does not read in the resource descriptions of submenus but simply records the menu ID of any submenu in the menu object. Submenu descriptions are read in with `GetMenu` and the submenu is inserted in the current menu list using `InsertMenu`, with the constant `hierMenu` passed as the second parameter to that call.

**NOTE**

As the user traverses menu items, if an item has a submenu, the `MenuSelect` function looks in the submenu portion of the menu list for the submenu. It then searches for a menu with a defined menu ID that matches the menu ID specified by the hierarchical menu item. If it finds a match, it attaches the submenu to the menu item.

**Carbon Note**

In Carbon, calling `GetMenu` twice on the same resource ID will create two independent, unique menus. (In Classic, the second call to `GetMenu` returns the same `MenuHandle` as the first call.) Thus, to prevent memory leaks in Carbon, `GetMenu` should not be called a second time on the same resource ID without an intervening call to `DisposeMenu`.

## Adding Menus to the Menu List

A menu may be added to the current menu list using one of the following procedures:

- Read the relevant 'MENU' resource in with `GetMenu`, add it to the current menu list with `InsertMenu`, and update the menu bar with `DrawMenuBar`.
- Use `NewMenu` to create a new empty menu, use `AppendMenu`, `InsertMenuItem`, `InsertResMenu`, or `AppendResMenu` to fill the menu with menu items, add the menu to the current menu list using `InsertMenu`, and update the menu bar using `DrawMenuBar`.

Note that `GetMenuRef` may be used to obtain a reference to the menu object of any menu in the current menu list.

## Providing Help Balloons (Mac OS 8/9)

### 'hmmu' Resources

For Mac OS 8/9, you should define Help balloons for each of your application's menu items and each menu title. Help balloons for menus are defined in 'hmmu' resources. The resource ID of an 'hmmu' resource should be the same as the resource ID of the 'MENU' resource to which it pertains.

### Creating 'hmmu' Resources

Fig 13 shows an 'hmmu' (help menu) resource being created using Resorcerer.



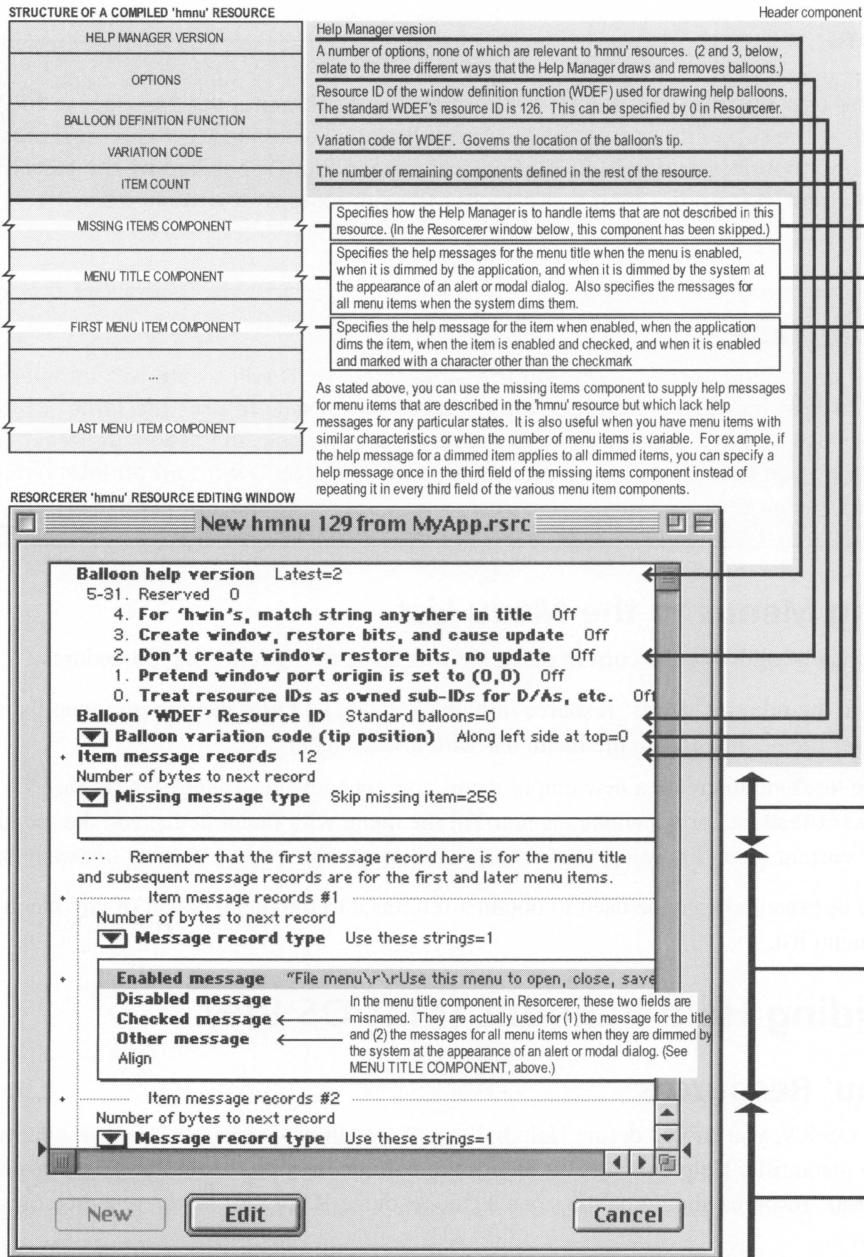


FIG 13 - CREATING AN 'hmnv' RESOURCE USING RESORCERER



### Specifying the Format of Help Messages.

The example at Fig 13 specifies the format of the help messages as (Pascal) text strings stored within the 'hmenu' resource itself. Clicking on the pop-up button adjacent to Message record type opens a pop-up menu that facilitates the choice of other formats (and also provides an option that enables you to instruct the Help Manager to skip the item). The items in the pop-up menu and their meanings are as follows:

<i>Pop-up Menu Item</i>	<i>Meaning to Help Manager</i>
Use these strings	Use the strings specified within this component of this 'hmenu' resource.
Use 'PICT' resources	Use the picture stored in the specified 'PICT' resource.
Use 'STR#' resources	Use the specified text string stored in the specified 'STR#' resource. (Storing the text strings in 'STR#' resources or 'STR ' resources (see below) simplifies the task of providing foreign language versions of your application.)
Used styled text resources	Use the styled text stored in the specified 'TEXT' and 'styl' resources.
Use 'STR ' resources	Use the text string stored in the specified 'STR ' resource.
Use named resource type	Use the resource ('STR ', 'PICT' or 'TEXT') whose name matches the name and state of the current menu item.
Skip missing item	No help message. Skip this item.
Compare item	Compare the specified comparison string against the current menu item in that position. If the specified string matches the name of the current menu item, display the help messages specified in the next four elements. (This is useful in the case of menu items that change names, for example Show Hidden Text and Hide Hidden Text.)

### Text for Help Balloons

The text of your help balloons for menus should answer at least one of the following questions:

- **What is this?** For example, when the user moves the cursor over the title of the File menu in the title bar, the beginning of the balloon text should be “File menu”.
- **What does this do?** For example, when the user moves the cursor over the Find item in a File menu, the balloon text should be “Finds and selects items with the characteristics you specify” or similar.

## Changing Menu Item Appearance

Menu Manager functions may be used to change the appearance of items in a menu, for example, the font style, text or other characteristics.

### Enabling and Disabling Menu Items

Specific menu items or entire menus may be disabled and enabled using `DisableMenuItem` and `EnableMenuItem`, which both take a reference to the menu object that identifies the desired menu and either the item number of the menu to be enabled/disabled or a value of 0 to indicate that the entire menu is to be enabled/disabled. Alternatively, if your application uses command IDs to identify menu items, you should use the functions `EnableMenuCommand` and `DisableMenuCommand` to enable and disable items.

When an entire menu is disabled or enabled, `DrawMenuBar` should be called to update the appearance of the menu bar. If you do not need to update the menu bar immediately, you can use `InvalidMenuBar` instead of `DrawMenuBar`, causing the Event Manager to redraw the menu bar the next time it scans for update events. This will reduce the menu bar flicker that will occur if `DrawMenuBar` is called more than once in rapid succession.

If you disable an entire menu, the Menu Manager dims that menu's title at the next call to `DrawMenuBar` and dims all menu items when it displays the menu. If you enable an entire menu, the Menu Manager enables only the menu title and any items that you did not previously disable individually.

### Enabling the Preferences... Item in the Application Menu

The Preferences... item in the Mac OS X Application menu is disabled by default. If your application needs to allow the user to invoke a Preferences dialog by choosing this item, it must explicitly enable the item. The following shows how to enable the Preferences... item:

```
EnableMenuCommand(NULL, kHICommandPreferences);
```

### Other Appearance Changes

The following lists other functions related to changing the appearance of menu items.

<i>Function</i>	<i>Description</i>
<code>SetMenuItemText</code>	Set and get the text.
<code>SetMenuItemTextWithCFString</code>	
<code>GetMenuItemText</code>	
<code>SetItemStyle</code>	Set and get the font style.
<code>GetItemStyle</code>	

<i>Function</i>	<i>Description</i>
SetItemMark GetItemMark	Set and get the marking character.
SetItemIcon GetItemIcon	Set and get the icon ('ICON' or 'cicn') using a resource ID.
CheckMenuItem	Places and removes a checkmark at the left of the item text.
SetMenuItemFontID GetMenuItemFontID	Set and get the font. SetMenuItemFontID allows you to set up a font menu with each item being drawn in the actual font.
SetMenuItemIconHandle GetMenuItemIconHandle	Set and get the icon (icon suite, 'ICON' or 'cicn') using an icon handle. Provides, in conjunction with the 'xmenu' resource, the support for icon suites introduced with Mac OS 8.
SetMenuItemKeyGlyph GetMenuItemKeyGlyph	SetMenuItemKeyGlyph substitutes a keyboard glyph for that normally displayed for a menu item's keyboard equivalent. GetMenuItemKeyGlyph gets the keyboard glyph for the keyboard equivalent.
SetMenuFont GetMenuFont	Set and get the font used in an individual menu.
SetMenuExcludesMarkColumn GetMenuExcludesMarkColumn	Set and get whether an individual menu contains space for marking characters.

## Adding Items to a Menu

### Adding Items Other Than the Names of Resources

AppendMenu, InsertMenuItem, AppendMenuItemText, AppendMenuItemTextWithCFString, InsertMenuItemText and InsertMenuItemTextWithCFString are used to add items other than the names of resources (such as font resources) to a previously created menu. They require:

- A reference to the menu object of the menu involved.
- A string describing the items to add.

### Strings with Metacharacters

AppendMenu and InsertMenuItem allow you to specify the same characteristics for menu items as are available when defining a 'MENU' resource. The string consists of the text of the menu item and any required characteristics. You can specify a hyphen as the menu item text to create

a divider. You can also use various **metacharacters** in the text string to separate menu items and to specify the required characteristics. The following metacharacters may be used:

<i>MetaCharacter</i>	<i>Description</i>
; or Return	Separates menu items.
^	When followed by an icon number, defines the icon for the item.
!	When followed by a character, defines the mark for the item. If the keyboard equivalent field contains 0x1B, this value is interpreted as the menu ID of a submenu of this menu item. <sup>1</sup>
<	When followed by one or more of the characters B, I, U, O, and S, defines the character style of the item to, respectively, bold, italic, underline, outline or shadow.
/	When followed by a character, defines the Command-key equivalent for the item. <sup>2</sup> When followed by 0x1B, specifies that this menu item has a submenu. <sup>1</sup> (Note: To specify that a menu item has a script code, reduced icon or small icon, use SetItemCmd to set the keyboard equivalent field to, respectively, 0x1C, 0x1D or 0x1E. <sup>3</sup> )
(	Defines the menu item as disabled.

As an example of the use of metacharacters, assume that the following two strings are stored in a string list ('STR#') resource:

```
Pick a Color...
(^2!=Everything<B/E
```

The second string in this resource uses metacharacters to specify that the menu item is to be disabled, that it has an icon with a resource ID 258 (2+256), that it has the “=” character as a marking character, that the text style is bold, and that the item has a Command-key equivalent of Command-E.

<sup>1</sup> Applicable only to menus without 'xmnu' resources. When 'xmnu' resources are used, use SetMenuItemHierarchicalID to attach a submenu to a menu item.

<sup>2</sup> When 'xmnu' resources are used, use SetMenuItemModifiers to set the extended modifier keys (Shift, Option, Control).

<sup>3</sup> Applicable only to menus without 'xmnu' resources. When 'xmnu' resources are used, do not use SetItemCmd to specify a script code. Use SetMenuItemTextEncoding.

**NOTE**

The Menu Manager adds 256 to the number you specify, and uses the result as the icon's resource ID.

**Examples**

The following code uses `AppendMenu` to append a menu item with no specific characteristics other than its text to the menu identified by the menu reference. The text for the menu item is "Pick a Color..." as stored in the preceding 'STR#' resource.

```
MenuRef menuRef;
Str255  itemString;
...
menuRef = GetMenuRef(mLibrary);
GetIndString(itemString,300,1);
AppendMenu(menuRef,itemString);
```

To insert an item after a given menu item, use `InsertMenuItem`. The following code inserts the menu item "Everything" after the menu item with the item number specified in the `iRed` constant:

```
MenuRef menuRef;
Str255  ItemString;
...
menuRef = GetMenuRef(mColors);
GetIndString(itemString,300,2);
InsertMenuItem(menuRef,itemString,iRed);
```

The following code appends multiple items to the Edit menu using `AppendMenu`:

```
MenuRef menuRef;
...
menuRef = GetMenuRef(mEdit);
AppendMenu(menuRef, "\pUndo/Z; -; Cut/X; Copy/C; Paste/V");
```

`InsertMenuItem` differs from `AppendMenu` in the way it handles the given text string when that string contains multiple items, inserting them in reverse order. This code is equivalent to the last line of the preceding code:

```
InsertMenuItem(menuRef, "\pPaste/V; Copy/C; Cut/X; -; Undo/Z", 0);
```

The following code adds a divider to the Edit menu:

```
AppendMenu(menuRef, "\p(-)");
```

## Strings Without Metacharacters

`AppendMenuItemText`, `AppendMenuItemTextWithCFString`, `InsertMenuItemText` and `InsertMenuItemTextWithCFString` append and insert the specified string without evaluating the string for metacharacters. These functions may be used if you have a need to present non-alphanumeric characters in a menu item.

## Adding Items Comprising Resource Names to a Menu

`AppendResMenu` or `InsertResMenu` may be used to add items that consist of resource names to a menu. For example, you can use `AppendResMenu` to add the names of all resident fonts as menu items in your application's Font menu.

## Associating Data with Menu Items

The following functions may be used by your application to associate data with menu items:

<i>Function</i>	<i>Description</i>
<code>SetMenuItemProperty</code>	Associates data with a menu item.
<code>GetMenuItemPropertySize</code>	Obtains the size of a piece of data that has been previously associated with a menu item.
<code>GetMenuItemProperty</code>	Obtains a piece of data that has been previously associated with a menu item.
<code>RemoveMenuItemProperty</code>	Removes a piece of data that has been previously associated with a menu item.

Note that these functions require a command ID to be passed in their second parameter. Accordingly, they may only be used when your application uses command IDs to refer to the relevant menu items.

## Handling Menu Choices

### Determining the Menu ID and Menu Item—`MenuSelect` and `MenuEvent`

The first action your application should take when the user presses the mouse button while the cursor is in the menu bar is menu adjustment (that is, enabling or disabling menu items and adding or removing marks as required). Your application should then call `MenuSelect`. `MenuSelect` tracks the mouse, displays menus, highlights menu titles, displays and highlights enabled menu items, handles all user activity until the user releases the mouse button, and returns a long integer as its function result. The long integer contains the menu ID in the high word and the item number in the low word.



If some of your menu items have keyboard equivalents, your application should detect such key-down events. If an examination of the `modifiers` field of the event structure reveals that the Command key was down, your application should first adjust its menus and then call `MenuEvent`. `MenuEvent` scans the current menu list for a menu item that has a matching keyboard equivalent. Like `MenuSelect`, `MenuEvent` returns a long integer containing the menu ID and the item number.

If the user did not actually choose a menu command with the mouse, or if the user pressed a keyboard combination that did not map to a keyboard equivalent, `MenuSelect` and `MenuEvent` return 0 in the high word, the value in the low word being undefined.

### Further Handling—Command IDs Not Used

The long integer returned by `MenuSelect` and `MenuEvent` should be passed as a parameter to a function that switches according to the menu ID in the high word and passes the low word to other functions that respond appropriately to that menu command.

### Further Handling—Command IDs Used

Mac OS 8 introduced an alternative method of identifying, for the purposes of further handling, the menu item chosen by the user. This method assumes that you have previously assigned a unique value to your individual menu items via the command ID field of the 'xmenu' resource (or, programmatically, via calls to `SetMenuItemCommandID`).

Using this method, the menu ID and item number should be extracted from the long integer returned by `MenuSelect` and `MenuEvent` in the usual way. The menu ID should then be used in a call to `GetMenuRef` to get the reference to the menu's menu object. This reference and the menu item should then be used in a call to `GetMenuItemCommandID`, which returns the unique value that you previously assigned to the item (that is, the item's command ID). Your application should then switch according to that command ID, calling the other functions that respond appropriately to that menu command.

## Unhighlighting the Menu Title

Recall that one of the actions of `MenuSelect` and `MenuEvent` is to highlight the menu title. Ordinarily, your application should not unhighlight the menu title (using `HiLiteMenu`) until it performs the action associated with the menu command chosen by the user. However, if, in response to a menu command, your application displays a modal dialog containing an edit text item, you should unhighlight the menu title immediately so that the user can access the Edit menu.

## Adjusting Menus

Menu adjustment should be on the basis of the type of window that is currently the frontmost window, for example, a text window, a modeless dialog, and so on. Accordingly, the menu

adjustment function should first determine which window is the front window. The following are examples of menu adjustment functions:

```
void doAdjustMenus(void)
{
    WindowRef windowRef;
    SInt16    windowType;

    windowRef = FrontWindow();
    windowType = doGetWindowType(windowRef);

    switch windowType
    {
        case kMyDocWindow:
            doAdjustFileMenuForDocWindow();
            doAdjustEditMenuForDocWindow();
            // Adjust others.
            break;

        case kMyModelessDialogWindow:
            doAdjustMenusForModelessDialogs();
            break;

        case kNil:
            doAdjustMenusNoWindows();
            break;
    };

    DrawMenuBar();
}

void doAdjustFileMenuForDocWindow(void)
{
    MenuRef menuRef;

    menuRef = GetMenuRef(mFile);

    EnableMenuItem (menuRef,iNew);
    EnableMenuItem (menuRef,iOpen);
    DisableMenuItem(menuRef,iClose);
    DisableMenuItem(menuRef,iSave);
    DisableMenuItem(menuRef,iSaveAs);
    DisableMenuItem(menuRef,iPageSetup);
    DisableMenuItem(menuRef,iPrint);
    EnableMenuItem (menuRef,iQuit);
}
```

## Handling Mac OS 8/9 Apple Menu Choices

When the user chooses an item in the Mac OS 8/9 Apple menu, `MenuSelect` returns the menu ID of your application's Apple menu in the high word and the item number in the low word.

If your application provides an About command as the first menu item in the Apple menu, and the user chooses this item, you should display the About dialog/alert. Other choices from the Mac OS 8/9 Apple menu are handled automatically by the system.

## Handling Mac OS X Application Menu Choices

### About Command

When the user chooses the About command in the Mac OS X Application menu, `MenuSelect` returns the menu ID of your application's Application menu in the high word and 1 in the low word. Thus the code that handles the user's choice of the Apple menu's About item on Mac OS 8/9 will also handle the user's choice of the Application menu's About item on Mac OS X.

### Quit Command

When the user chooses the Quit command from the Mac OS X Application menu, a high-level event (more specifically, an Apple event) known as a Quit Application event is sent to your application. Your application must support the Quit Application event in order to respond to the user choosing the Quit command (see Chapter 10).

### Preferences... Command

An Apple Event, known as the Show Preferences event, is sent to your application when the user chooses the Preferences... command from the Mac OS X Application menu. Your application must support the Show Preferences event in order to respond to the user choosing the Preferences...command. (See the demonstration program in Chapter 19.)

## Handling a Size Menu

### Preamble

On Mac OS 8/9, font sizes in Size menus should be outlined to indicate which sizes are directly provided by the current font. For bitmapped fonts, you should outline only those sizes that exist in the Fonts folder. For TrueType fonts, all sizes supported by that font should be outlined. The current font size should be indicated with a checkmark. If the current selection contains more than one font size, a dash should be placed next to each font size in the selection.

Size menus should, in addition to displaying available font sizes, provide an Other command to enable the user to specify a size not currently listed in the menu. When the user chooses the Other command, the current font size should be displayed in a dialog which allows the user to enter the desired font size. If the user chooses a size not already in the menu, a checkmark should be added to the Other menu item and the chosen size should be added in parenthesis to the text of the Other command.

## Handling the Menu Choice

The following is an example function that handles a user's choice of an item in a Size menu:

```
void doHandleSizeCommand(SInt16 menuItem)
{
    SInt16 numItems;
    Boolean addItem;
    SInt32 sizeChosen;

    numItems = CountMenuItems(GetMenuHandle(mSize));
    if(menuItem == numItems)           // If user chose Other, display dialog. If the
    {                                  // user-specified size is not in the menu, add a
        doDisplayOtherBox(sizeChosen); // checkmark to the Other command and add the new
    }                                  // font size to the text of the Other command.
    else                               // Return sizeChosen.
    {                                  // User chose a size.
        doRemoveMarksFromSizeMenu(); // Remove marks from item/s showing previous size.
        CheckMenuItem(GetMenuHandle(mSize),menuItem,true); // Add mark to chosen item.
        sizeChosen = doItemToSize(menuItem); // Convert item number to font size.
    }
    doResizeSelection(sizeChosen);      // Update document state or user selection.
}
```

## Hiding and Showing the Menu Bar

HideMenuBar and ShowMenuBar may be used to make the menu bar invisible and unselectable and visible and selectable. On Mac OS X, these functions also hide and show the Dock.

## Accessing Menus from Alerts and Dialogs

When alerts and dialogs are displayed, the Dialog Manager and the Menu Manager interact to provide varying degrees of access to menus in your menu bar. In some circumstances, you can rely on the system software to disable the appropriate menus and menu items. In other circumstances, your application must contribute to, or control, the matter of menu access.

The subject of menu access when alerts, movable alerts, modal dialogs, moveable modal dialogs, and modeless dialogs are displayed is somewhat involved, and is addressed in detail in Chapter 8.

## Main Menu Manager Constants, Data Types, and Functions

### Constants

#### For markChar Parameter of SetItemMark Calls

```
noMark      = 0
commandMark = 17
checkMark   = 18
diamondMark = 19
appleMark   = 20
```

## For beforeID Parameter of InsertMenu to Insert a Submenu into the Submenu Portion of the Menu List

```
hierMenu      = -1
```

## For options Parameter of CreateStandardFontMenu Calls

```
KHierarchicalFontMenuOption = 0x00000001
```

## Modifier Key Masks for GetMenuitemModifiers and SetMenuitemModifiers Calls

```
kMenuCommandModifiers = 0      If no bit is set, only the Command key is used.
kMenuShiftModifier    = (1 << 0) If this bit (bit 0) is set, the Shift key is used.
kMenuOptionModifier   = (1 << 1) If this bit (bit 1) is set, the Option key is used.
kMenuControlModifier  = (1 << 2) If this bit (bit 2) is set, the Control key is used.
kMenuNoCommandModifier = (1 << 3) If this bit (bit 3) is set, the Command key is not used.
```

## Menu Icon Handle Constants for GetMenuitemIconHandle and SetMenuitemIconHandle Calls

```
kMenuNoIcon          = 0  No icon.
kMenuIconType        = 1  'ICON' handle.
kMenuShrinkIconType  = 2  32-by-32 'ICON' handle shrunk (at display time) to 16-by-16.
kMenuSmallIconType   = 3  'SICON' handle.
kMenuColorIconType   = 4  'cicn' handle.
kMenuIconSuiteType   = 5  Icon suite handle.
```

## Menu Attributes

```
kMenuAttrExcludesMarkColumn = (1 << 0)
kMenuAttrAutoDisable        = (1 << 2)
```

## Data Types

```
typedef struct OpaqueMenuHandle* MenuHandle;
typedef MenuHandle MenuRef;
typedef SInt16 MenuID;
typedef UInt16 MenuItemIndex;
typedef UInt32 MenuCommand;
typedef Handle MenuBarHandle;
typedef UInt32 MenuAttributes;
```

## Functions

### Creating and Disposing of Menus

```
MenuRef NewMenu(MenuID menuID, ConstStr255Param menuTitle);
MenuRef GetMenu(short resourceID);
void DisposeMenu(MenuRef theMenu);
```

### Creating a Help Menu (Mac OS X)

```
OSStatus HMGetHelpMenu(MenuRef *outHelpMenu, MenuItemIndex *outFirstCustomItemIndex);
```

### Adding Menus to and Removing Menus from the Current Menu List

```
void InsertMenu(MenuRef theMenu, MenuID beforeID);
void DeleteMenu(MenuID menuID);
void ClearMenuBar(void);
```

## Getting a MenuBar Description from an 'MBAR' resource

```
MenuBarHandle GetNewMBar(short menuBarID);
```

## Getting, Setting and Disposing of the Menu Bar

```
MenuBarHandle GetMenuBar(void);
void SetMenuBar(MenuBarHandle mbar);
OSStatus DisposeMenuBar(MenuBarHandle mbar);
short GetMBarHeight(void);
```

## Drawing the Menu Bar

```
void DrawMenuBar(void);
void InvalMenuBar(void);
```

## Controlling Menu Bar Visibility

```
void HideMenuBar(void);
void ShowMenuBar(void);
Boolean IsMenuBarVisible(void);
```

## Modifying the Menu Width

```
Boolean GetMenuExcludesMarkColumn(MenuRef menu);
OSStatus SetMenuExcludesMarkColumn(MenuRef menu, Boolean excludesMark);
```

## Responding to User Choice of a Menu Command

```
UInt32 MenuEvent(const EventRecord *inEvent);
long MenuSelect(Point startPt);
long MenuChoice(void);
void HiliteMenu(MenuID menuID);
long PopUpMenuSelect(MenuRef menu, short top, short left, short popUpItem);
```

## Getting a Reference to a Menu object

```
MenuRef GetMenuRef(MenuID menuID);
```

## Adding and Deleting Menu Items

```
void AppendMenu(MenuRef menu, ConstStr255Param data);
void InsertMenuItem(MenuRef theMenu, ConstStr255Param itemString, short afterItem);
OSStatus AppendMenuItemText(MenuRef menu, ConstStr255Param inString);
OSStatus AppendMenuItemTextWithCFString(MenuRef menu, CFStringRef inString,
    MenuItemAttributes inAttributes, MenuCommand inCommandID, MenuItemIndex *outNewItem);
OSStatus InsertMenuItemText(MenuRef menu, ConstStr255Param inString, UInt16 afterItem);
OSStatus InsertMenuItemTextWithCFString(MenuRef menu, CFStringRef inString,
    MenuItemIndex inAfterItem, MenuItemAttributes inAttributes, MenuCommand inCommandID);
void DeleteMenuItem(MenuRef theMenu, short item);
void AppendResMenu(MenuRef theMenu, ResType theType);
void InsertResMenu(MenuRef theMenu, ResType theType, short afterItem);
```

## Enabling and Disabling Menus, Menu Items, and Menu Item Icons

```
void EnableMenuItem(MenuRef theMenu, MenuItemIndex item);
void DisableMenuItem(MenuRef theMenu, MenuItemIndex item);
Boolean IsMenuItemEnabled(MenuRef menu, MenuItemIndex item);
void DisableAllMenuItems(MenuRef theMenu);
void EnableAllMenuItems(MenuRef theMenu);
```



```

Boolean  MenuHasEnabledItems(MenuRef theMenu);
void     EnableMenuCommand(MenuRef theMenu,MenuCommand commandID);
void     DisableMenuCommand(MenuRef theMenu,MenuCommand commandID);
Boolean  IsMenuCommandEnabled(MenuRef menu,MenuCommand commandID);
void     EnableMenuItemIcon(MenuRef theMenu,MenuItemIndex item);
void     DisableMenuItemIcon(MenuRef theMenu,MenuItemIndex item);
Boolean  IsMenuItemIconEnabled(MenuRef menu,MenuItemIndex item);

```

## Getting and Setting Menu Item Command IDs

```

OSErr    GetMenuItemCommandID(MenuRef inMenu,SInt16 inItem,UInt32 *outCommandID);
OSErr    SetMenuItemCommandID(MenuRef inMenu,SInt16 inItem,UInt32 inCommandID);

```

## Menu Object Accessor Functions

```

MenuID    GetMenuID(MenuRef menu);
void      SetMenuID(MenuRef menu,MenuID menuID);
SInt16    GetMenuWidth(MenuRef menu);
void      SetMenuWidth(MenuRef menu,SInt16 width);
SInt16    GetMenuHeight(MenuRef menu);
void      SetMenuHeight(MenuRef menu,SInt16 height);
StringPtr GetMenuTitle(MenuRef menu,Str255 title);
OSStatus  SetMenuTitle(MenuRef menu,ConstStr255Param title);
OSStatus  SetMenuTitleWithCFString(MenuRef menu,CFStringRef inString);
OSStatus  GetMenuDefinition(MenuRef menu,MenuDefSpecPtr outDefSpec);
OSStatus  SetMenuDefinition (MenuRef menu,const MenuDefSpec *defSpec);

```

## Manipulating and Accessing Menu Item Characteristics

```

void      GetMenuItemText(MenuRef menu,short item,Str255 itemString);
void      SetMenuItemText(MenuRef theMenu, short item, ConstStr255Param itemString);
OSStatus  SetMenuItemTextWithCFString(MenuRef menu,MenuItemIndex item,CFStringRef inString);
void      GetItemStyle(MenuRef theMenu,short item,Style* chStyle);
void      SetItemStyle(MenuRef theMenu,short item, StyleParameter chStyle);
void      GetItemMark(MenuRef theMenu,short item,CharParameter *markChar);
void      SetItemMark(MenuRef theMenu,short item,CharParameter markChar);
void      CheckMenuItem(MenuRef theMenu,short item,Boolean checked);
OSStatus  GetMenuFont(MenuRef menu,SInt16 *outFontID,UInt16 *outFontSize);
OSStatus  SetMenuFont(MenuRef menu,SInt16 inFontID,UInt16 inFontSize);
void      GetItemIcon(MenuRef theMenu,short item,short *iconIndex);
void      SetItemIcon(MenuRef theMenu,short item,short iconIndex);
void      GetItemCmd(MenuRef theMenu,short item,short *cmdChar);
void      SetItemCmd(MenuRef theMenu,short item,short cmdChar);
OSErr     GetMenuItemFontID(MenuRef inMenu,SInt16 inItem,SInt16* outFontID);
OSErr     SetMenuItemFontID(MenuRef inMenu,SInt16 inItem,SInt16 inFontID);
OSErr     GetMenuItemHierarchicalID(MenuRef inMenu,SInt16 inItem,SInt16 *outHierID);
OSErr     SetMenuItemHierarchicalID(MenuRef inMenu,SInt16 inItem,SInt16 inHierID);
OSErr     GetMenuItemIconHandle(MenuRef inMenu,SInt16 inItem,MenuItemType outIconType,
Handle* outIconHandle);
OSErr     SetMenuItemIconHandle(MenuRef inMenu,SInt16 inItem,MenuItemType inIconType,
Handle inIconHandle);
OSErr     GetMenuItemKeyGlyph(MenuRef inMenu,SInt16 inItem,SInt16 *outGlyph);
OSErr     SetMenuItemKeyGlyph(MenuRef inMenu,SInt16 inItem,SInt16 inGlyph);
OSErr     GetMenuItemModifiers(MenuRef inMenu,SInt16 inItem,SInt16* outModifiers);
OSErr     SetMenuItemModifiers(MenuRef inMenu,SInt16 inItem,SInt16 inModifiers);
OSErr     GetMenuItemRefCon(MenuRef inMenu,SInt16 inItem,SInt32* outRefCon);

```

```

OSErr      SetMenuItemRefCon(MenuRef inMenu,SInt16 inItem,SInt32 inRefCon);
OSErr      GetMenuItemTextEncoding(MenuRef inMenu,SInt16 inItem,TextEncoding* outScriptID);
OSErr      SetMenuItemTextEncoding(MenuRef inMenu,SInt16 inItem,TextEncoding inScriptID);

```

### Getting a Menu Reference and Menu ID from a Command ID

```

OSStatus    GetIndMenuItemWithCommandID(MenuRef menu,MenuCommand commandID,UInt32 itemIndex,
MenuRef *outMenu,MenuItemIndex *outIndex);

```

### Associating Data with Menu Items

```

OSStatus    SetMenuCommandProperty(MenuRef menu,MenuCommand commandID,OSType propertyCreator,
OSType propertyTag,ByteCount propertySize,const void *propertyData);
OSStatus    GetMenuCommandPropertySize(MenuRef menu,MenuCommand commandID,OSType propertyCreator,
OSType propertyTag,ByteCount *size);
OSStatus    GetMenuCommandProperty(MenuRef menu,MenuCommand commandID,OSType propertyCreator,
OSType propertyTag,ByteCount bufferSize,ByteCount *actualSize,void *propertyBuffer);
OSStatus    RemoveMenuCommandProperty(MenuRef menu,MenuCommand commandID,OSType propertyCreator,
OSType propertyTag);

```

### Counting Items in a Menu

```

short       CountMenuItems(MenuRef theMenu);
ItemCount    CountMenuItemsWithCommandID(MenuRef menu,MenuCommand commandID);

```

### Building and Updating Font Menus and Obtaining Font Family and Style

```

OSStatus    CreateStandardFontMenu(MenuRef menu,MenuItemIndex afterItem,MenuID firstHierMenuID,
OptionBits options,ItemCount *outHierMenuCount);
OSStatus    UpdateStandardFontMenu(MenuRef menu,ItemCount *outHierMenuCount);
OSStatus    GetFontFamilyFromMenuSelection(MenuRef menu,MenuItemIndex item,
FMPFontFamily *outFontFamily,FMPFontStyle *outStyle);

```

### Recalculating Menu Dimensions

```

void         CalcMenuSize(MenuRef theMenu);

```

### Highlighting the Menu Bar

```

void         FlashMenuBar(MenuID menuID);

```

## Demonstration Program Menus1 Listing

```

// *****
// Menus1.c CLASSIC EVENT MODEL
// *****
//
// This program:
//
// · Opens a window.
//
// · Creates these pull-down menus: Apple, File, Edit, Font, Size, Special, and Window.
//
// · Displays text in the window indicating the menu selection made by the user.
//
// The Apple menu includes an "About..." menu item for the program.
//

```

```

// The second menu item in the Special menu contains a submenu.
//
// The Font and Window menus are created programmatically using the functions
// CreateStandardFontMenu and CreateStandardWindowMenu.
//
// The implementation of the Size menu is nominal only. The current size is indicated with a
// checkmark; however, the number of sizes shown is not font-dependent and there is no "Other"
// item.
//
// Because the primary purpose of the program is to demonstrate menu creation and handling, no
// code is included to update and activate/deactivate the window or to respond to events which
// are not relevant to the demonstration.
//
// The program is terminated by selecting Quit from the File menu, by pressing the keyboard
// equivalent for that item (Command-Q), or by clicking in the window's go-away box/close
// button.
//
// The program utilises the following resources:
//
// • A 'plst' resource.
//
// • A 'WIND' resource (purgeable) (initially not visible).
//
// • An 'MBAR' resource (preload, non-purgeable).
//
// • 'MENU' resources for the Apple, File, Edit, Font, Size, and Special drop-down menus
//   and the submenu (all preload, all non-purgeable).
//
// • A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****
// ..... includes
//
#include <Carbon.h>
// ..... defines
//
#define rMenubar          128
#define mAppleApplication 128
#define iAbout            1
#define mFile             129
#define iQuit             12
#define mEdit             130
#define iUndo             1
#define iCut              3
#define iCopy             4
#define iPaste            5
#define iClear            6
#define mFont             131
#define mSize             132
#define iTen              1
#define iTwelve           2

```

```

#define iEighteen      3
#define iTwentyFour   4
#define mSpecial       133
#define iFirstItem     1
#define iSecondItem    2
#define mWindow        134
#define mSubMenu        135
#define mFirstFontSubMenu 136
#define iFirstSubItem   1
#define iSecondSubItem  2
#define rWindowResource 128

// ..... global variables

Boolean      gDone;
ItemCount    gFontMenuHierMenuCount;
MenuItemIndex gCurrentFontSizeItem = 2;
MenuItemIndex gCurrentFontMenuItem;
MenuItemIndex gCurrentFontSubMenuItem;
MenuRef      gCurrentFontSubMenuRef = NULL;

// ..... function prototypes

void main          (void);
void doPreliminaries (void);
OSErr quitAppEventHandler (AppleEvent *,AppleEvent *,SInt32);
void doGetMenus     (void);
void doEvents       (EventRecord *);
void doMouseDown    (EventRecord *);
void doAdjustMenus  (void);
void doMenuChoice    (SInt32);
void doAppleApplicationMenu (MenuItemIndex);
void doFileMenu      (MenuItemIndex);
void doEditMenu      (MenuItemIndex);
void doFontMenu      (MenuID,MenuItemIndex);
void doSizeMenu      (MenuItemIndex);
void doSpecialMenu    (MenuItemIndex);
void doSubMenus      (MenuItemIndex);
void drawItemString  (Str255);

// ***** main

void main(void)
{
    EventRecord eventStructure;
    WindowRef   windowRef;

    // ..... do preliminaries

    doPreliminaries();

    // ..... open a window

```

```

if(!(windowRef = GetNewCWindow(rWindowResource,NULL,(WindowRef) -1)))
{
    SysBeep(10);
    ExitToShell();
}

SetPortWindowPort(windowRef);

// ..... set up menu bar and menus, then show window

doGetMenus();
ShowWindow(windowRef);

// ..... event loop

gDone = false;

while(!gDone)
{
    if(WaitNextEvent(everyEvent,&eventStructure,180,NULL))
        doEvents(&eventStructure);
}
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    OSErr osError;

    MoreMasterPointers(640);
    InitCursor();
    FlushEvents(everyEvent,0);

    osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
        NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
        0L,false);

    if(osError != noErr)
        ExitToShell();
}

// ***** doQuitAppEvent

OSErr quitAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,SInt32 handlerRefcon)
{
    OSErr osError;
    DescType returnedType;
    Size actualSize;

    osError = AEGetAttributePtr(appEvent,keyMissedKeywordAttr,typeWildCard,&returnedType,NULL,0,
        &actualSize);

    if(osError == errAEDescNotFound)

```

```

    {
        gDone = true;
        osError = noErr;
    }
    else if (osError == noErr)
        osError = errAERParamMissed;

    return osError;
}

// ***** doGetMenus

void doGetMenus(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;
    MenuRef        menuRef;
    OSStatus       osError;
    Str255         smallSystemFontName, itemString;
    SInt16         numberOfItems, a;

    // ..... get and set, and menu bar

    menubarHdl = GetNewMBar(rMenubar);
    if (menubarHdl == NULL)
        ExitToShell();
    SetMenuBar(menubarHdl);

    // ..... if running on Mac OS X, delete Quit item and preceding divider from File menu

    Gestalt(gestaltMenuMgrAttr, &response);
    if (response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
        if (menuRef != NULL)
        {
            DeleteMenuItem(menuRef, iQuit);
            DeleteMenuItem(menuRef, iQuit - 1);
            DisableMenuItem(menuRef, 0);
        }
    }

    // ..... create hierarchical Font menu, checkmark small system font

    menuRef = GetMenuRef(mFont);
    if (menuRef != NULL)
    {
        osError = CreateStandardFontMenu(menuRef, 0, mFirstFontSubMenu, kHierarchicalFontMenuOption,
                                          &gFontMenuHierMenuCount);
        if (osError != noErr)
            ExitToShell();
    }
}

```



```

else
    ExitToShell();

    GetFontName(kThemeSmallSystemFont,smallSystemFontName);
numberOfItems = CountMenuItems(menuRef);
for(a=1;a<numberOfItems + 1;a++)
{
    GetMenuItemText(menuRef,a,itemString);
    if(EqualString(itemString,smallSystemFontName,false,false))
    {
        CheckMenuItem(menuRef,a,true);
        gCurrentFontMenuItem = a;
        break;
    }
}

// ..... create Window menu and insert into menu list

CreateStandardWindowMenu(0,&menuRef);
SetMenuID(menuRef,mWindow);
InsertMenu(menuRef,0);

// ..... get submenus and insert into window list

menuRef = GetMenu(mSubmenu);
if(menuRef != NULL)
    InsertMenu(menuRef,hierMenu);
else
    ExitToShell();

// ..... set initial font size and checkmark associated item in Size menu

doSizeMenu(gCurrentFontSizeItem);

// ..... draw menu bar

DrawMenuBar();
}

// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEResponseAppleEvent(eventStrucPtr);
            break;

        case mouseDown:
            doMouseDown(eventStrucPtr);
            break;
    }
}

```

```

    case keyDown:
        if((eventStrucPtr->modifiers & cmdKey) != 0)
        {
            doAdjustMenus();
            doMenuChoice(MenuEvent(eventStrucPtr));
        }
        break;

    case updateEvt:
        BeginUpdate((WindowRef) eventStrucPtr->message);
        EndUpdate((WindowRef) eventStrucPtr->message);
        break;
}
}

// ***** doMouseDown

void doMouseDown(EventRecord *eventStrucPtr)
{
    WindowRef      windowRef;
    WindowPartCode partCode;
    SInt32          menuChoice;

    partCode = FindWindow(eventStrucPtr->where,&windowRef);

    switch(partCode)
    {
        case inMenuBar:
            doAdjustMenus();
            menuChoice = MenuSelect(eventStrucPtr->where);
            doMenuChoice(menuChoice);
            break;

        case inContent:
            if(windowRef != FrontWindow())
                SelectWindow(windowRef);
            break;

        case inDrag:
            DragWindow(windowRef,eventStrucPtr->where,NULL);
            break;

        case inGoAway:
            if(TrackGoAway(windowRef,eventStrucPtr->where))
                gDone = true;
            break;
    }
}

// ***** doAdjustMenus

void doAdjustMenus(void)

```

```

{
    // Adjust menus here.
}

// ***** doMenuChoice

void doMenuChoice(SInt32 menuChoice)
{
    MenuID          menuID;
    MenuItemIndex   menuItem;

    menuID          = HiWord(menuChoice);
    menuItem         = LoWord(menuChoice);

    if(menuID == 0)
        return;

    if(menuID == mFont || ((menuID >= mFirstFontSubMenu) &&
                           (menuID <= mFirstFontSubMenu + gFontMenuHierMenuCount)))
        doFontMenu(menuID, menuItem);
    else
    {
        switch(menuID)
        {
            case mAppleApplication:
                doAppleApplicationMenu(menuItem);
                break;

            case mFile:
                doFileMenu(menuItem);
                break;

            case mEdit:
                doEditMenu(menuItem);
                break;

            case mSize:
                doSizeMenu(menuItem);
                break;

            case mSpecial:
                doSpecialMenu(menuItem);
                break;

            case mSubmenu:
                doSubMenus(menuItem);
                break;
        }
    }

    HiliteMenu(0);
}

```

```

// ***** doAppleApplicationMenu

void doAppleApplicationMenu(MenuItemIndex menuItem)
{
    if(menuItem == iAbout)
        drawItemString("\pAbout Menus1");
}

// ***** doFileMenu

void doFileMenu(MenuItemIndex menuItem)
{
    if(menuItem == iQuit)
        gDone = true;
}

// ***** doEditMenu

void doEditMenu(MenuItemIndex menuItem)
{
    switch(menuItem)
    {
        case iUndo:
            drawItemString("\pUndo");
            break;

        case iCut:
            drawItemString("\pCut");
            break;

        case iCopy:
            drawItemString("\pCopy");
            break;

        case iPaste:
            drawItemString("\pPaste");
            break;

        case iClear:
            drawItemString("\pClear");
            break;
    }
}

// ***** doFontMenu

void doFontMenu(MenuID menuID, MenuItemIndex menuItem)
{
    MenuRef      menuRef, fontMenuRef;
    OSStatus     osError;
    FMFontFamily currentFontFamilyReference;
    FMFontStyle  currentFontStyle;
    Str255       fontName, styleName, itemName;
    SInt16       a, numberOfFontMenuItems;

```

```

menuRef = GetMenuRef(menuID);

osError = GetFontFamilyFromMenuSelection(menuRef,menuItem,&currentFontFamilyReference,
                                          &currentFontStyle);

if(osError == noErr)
{
    TextFont(currentFontFamilyReference);
    TextFace(currentFontStyle);

    GetFontName(currentFontFamilyReference,fontName);
    drawItemString(fontName);

    if(menuID == mFont)
    {
        CheckMenuItem(menuRef,gCurrentFontMenuItem,false);
        gCurrentFontMenuItem = menuItem;
        CheckMenuItem(menuRef,gCurrentFontMenuItem,true);

        if(gCurrentFontSubMenuRef != NULL)
            CheckMenuItem(gCurrentFontSubMenuRef,gCurrentFontSubMenuItem,false);
    }
    else
    {
        if(gCurrentFontSubMenuRef != NULL)
            CheckMenuItem(gCurrentFontSubMenuRef,gCurrentFontSubMenuItem,false);
        gCurrentFontSubMenuRef = menuRef;
        gCurrentFontSubMenuItem = menuItem;
        CheckMenuItem(gCurrentFontSubMenuRef,gCurrentFontSubMenuItem,true);

        fontMenuRef = GetMenuRef(mFont);
        CheckMenuItem(fontMenuRef,gCurrentFontMenuItem,false);

        numberOfFontMenuItems = CountMenuItems(fontMenuRef);

        for(a=1;a<=numberOfFontMenuItems;a++)
        {
            GetMenuItemText(fontMenuRef,a,itemName);
            if(EqualString(fontName,itemName,true,true))
            {
                gCurrentFontMenuItem = a;
                break;
            }
        }

        SetItemMark(fontMenuRef,gCurrentFontMenuItem,'-');

        GetMenuItemText(menuRef,menuItem,styleName);
        DrawString("\p ");
        DrawString(styleName);
    }
}
else
    ExitToShell();
}

```

```
// ***** doSizeMenu

void doSizeMenu(MenuItemIndex menuItem)
{
    MenuRef sizeMenuRef;

    switch(menuItem)
    {
        case iTen:
            TextSize(10);
            break;

        case iTwelve:
            TextSize(12);
            break;

        case iEighteen:
            TextSize(18);
            break;

        case iTwentyFour:
            TextSize(24);
            break;
    }

    sizeMenuRef = GetMenuRef(mSize);

    CheckMenuItem(sizeMenuRef,gCurrentFontSizeItem,false);
    CheckMenuItem(sizeMenuRef,menuItem,true);

    gCurrentFontSizeItem = menuItem;

    drawItemString("\pSize change");
}

// ***** doSpecialMenu

void doSpecialMenu(MenuItemIndex menuItem)
{
    if(menuItem == iFirstItem)
        drawItemString("\pFirst Item");
}

// ***** doSubMenus

void doSubMenus(MenuItemIndex menuItem)
{
    switch(menuItem)
    {
        case iFirstSubItem:
            drawItemString("\pSubitem 1");
            break;
    }
}
```



```

        case iSecondSubItem:
            drawItemString("\pSubitem 2");
            break;
    }
}

// ***** drawItemString

void drawItemString(Str255 eventString)
{
    RgnHandle tempRegion;
    WindowRef windowRef;
    Rect      scrollBox;

    windowRef = FrontWindow();
    tempRegion = NewRgn();

    GetWindowPortBounds(windowRef,&scrollBox);

    ScrollRect(&scrollBox,0,-24,tempRegion);
    DisposeRgn(tempRegion);

    MoveTo(8,286);
    DrawString(eventString);
}

// *****

```

## Demonstration Program Menus1 Comments

When this program is run, the user should choose items from all menus, including the Apple menu. Selections should be made using the mouse and, where appropriate, the Command key equivalents. The user should also note the effects on the menu bar of clicking outside, then inside, the program's window, that is, of sending the program to the background and returning it to the foreground.

### defines

Constants are established for the pull-down and submenu menu IDs and associated resource IDs, menu item numbers and subitem numbers.

The Menu Manager function `CreateStandardFontMenu` will be used to create a hierarchical Font menu and `mFirstFontSubMenu` establishes the ID of the first Font menu submenu to be created.

The last line establishes a constant for the resource ID of the 'WIND' resource.

### Global Variables

`gFontMenuHierMenuCount` will be assigned a value representing the number of submenus created by the Menu Manager function `CreateStandardFontMenu`.

`gCurrentFontSizeItem` will be assigned the menu item number of the chosen font size.

`gCurrentFontMenuItem` and `gCurrentFontSubMenuItem` will be used in the Font menu handling function to specify which menu and submenu items are to have a checkmark added or cleared. `gCurrentFontSubMenuRef` will be assigned a reference to the menu object for the currently chosen Font menu submenu.

### **main**

The `main()` function creates a window and makes its graphics port the current port, calls `doGetMenus` to set up the menus, shows the window and enters the main event loop.

### **doPreliminaries**

The large number of master pointers created by `MoreMasterPointers` in this program allows for the likely creation of a large number of submenus by the Menu Manager function `CreateStandardFontMenu`.

When the program is run on Mac OS X, the Quit item will be in the Application menu. The system informs the program of the user's choice of this item via a high-level event known as an Apple event, more specifically, an Apple event known as the Quit Application event. The call to `AEInstallEventHandler` installs `quitAppEventHandler` as the handler for this high-level event. (Apple events and Apple event handlers are explained in Chapter 10.)

### **quitAppEventHandler**

`quitAppEventHandler` is the handler for the Quit Application event installed in `doPreliminaries`. Basically, it sets the global variable `gDone` to true, which causes the program to terminate from the main event loop.

### **doGetMenus**

`doGetMenus` sets up the menu bar and the various menus.

At the first block, `GetNewMBar` reads in the 'MENU' resources for each menu specified in the 'MBar' resource and creates a menu object for each of those menus. (Note that the error handling here and in other areas of this program is somewhat rudimentary: the program simply terminates.) The call to `SetMenuBar` makes the newly created menu list the current list.

The call to `Gestalt` determines whether the application is running on Mac OS 8/9 or Mac OS X. If the application is running on Mac OS X, `GetMenuRef` is called to get a reference to the menu object for the File menu and `DeleteMenuItem` is called to delete the Quit item and its preceding divider from the menu.

The third block utilizes the relatively new Menu Manager function `CreateStandardFontMenu` to create a hierarchical font menu. A reference to the Font menu object is passed in the first parameter. The third parameter specifies the menu ID for the first submenu to be created. The

fourth parameter specifies that the Font menu be created as a hierarchical menu. The fifth parameter receives a value representing the number of submenus created.

CreateStandardFontMenu itself inserts these submenus into the submenu portion of the menu list.

The fourth block checkmarks the Font menu item containing the name of the small system font. GetFontName gets the name of the small system font and CountMenuItems counts the number of items in the Font menu. The for loop then walks the items in the Font menu looking for a match. When it finds a match, CheckMenuItem is called to checkmark the item, the global variable which keeps track of the currently selected font is assigned the number of that item, and the for loop is exited.

The fifth block creates the Window menu using the Window Manager function CreateStandardWindowMenu. The accessor function SetMenuID sets the menu's ID and InsertMenu inserts the menu into the menu list. (Setting the menu ID is for illustrative purposes only because the ID is not used in this demonstration. Since the system handles the standard Window menu automatically, an ID is ordinarily only required for menu adjustment purposes when the menu has been customised.)

The sixth block inserts a further single submenu (to be attached to the second item in the Special menu) into the submenu portion of the menu list. GetNewMBar does not read in the resource descriptions of submenus, so the first step is to read in the 'MENU' resource with GetMenu. InsertMenu inserts a menu reference for this menu into the menu list at the location specified in the second parameter to this call. Using the constant hierMenu (-1) as the second parameter causes the menu to be installed in the submenu portion of the menu list.

The last line causes a checkmark to be set against the Size menu item corresponding to the initialised value of the global variable gCurrentFontSizeItem.

DrawMenuBar draws the menu bar.

Note that, in Carbon, the contents of the Apple Menu Items folder are automatically added to the Apple menu.

## doEvents

doEvents switches according to the type of low-level or Operating System event received. Further processing is called for in the case of mouse-down or Command key equivalents, these being central to the matter of menu handling.

At the keyDown case, a check is made of the modifiers field of the event structure to establish whether the Command key was also pressed at the time. If so, menu enabling/disabling is attended to before the call to MenuEvent establishes whether the character code is associated with a currently enabled menu or submenu item in the menu list. If a match is found,

`MenuEvent` returns a long integer containing the menu ID in the high word and the item number in the low word, otherwise it returns 0 in the high word. This long integer is then passed to the function `doMenuChoice`.

### **doMouseDown**

`doMouseDown` first establishes the window and window part in which the mouse-down event occurred, and switches accordingly. This demonstration program is specifically concerned with mouse-downs in the menu bar and the content region of the window.

If the event occurred in this program's menu bar, menu enabling/disabling is attended to before the call to `MenuSelect`. `MenuSelect` tracks the user's actions until the mouse button is released, at which time it returns a long integer. If the user actually chose a menu item, this long integer contains the menu ID in the high word and the item number in the low word, otherwise it contains 0 in the high word. This long integer is passed to the function `doMenuChoice`.

If the mouse-down event occurred in the content region of the window, and if the window to which the mouse-down refers is not the front window, `SelectWindow` is called to effect basic window activation/deactivation.

### **doAdjustMenus**

`doAdjustMenus` is called when a mouse-down occurs in the menu bar and when examination of a key-down event reveals that a menu item's keyboard equivalent has been pressed. No action is required in this simple program.

Later demonstration programs contain examples of menu adjustment functions.

### **doMenuChoice**

`doMenuChoice` takes the long integer returned by the `MenuSelect` and `MenuEvent` calls, extracts the high word (the menu ID) and the low word (the menu item number) and switches according to the menu ID.

At the first two lines, the menu ID and the menu item number are extracted from the long integer. The next two lines will cause an immediate return if the high word equals 0, (meaning that either the mouse button was released when the pointer was outside the menu box or `MenuEvent` found no menu list match for the key pressed in conjunction with the Command key).

If the menu ID represents either the Font menu or one of the Font menu's submenus, the menu handling function `doFontMenu` is called. Otherwise, the function switches on the menu ID so that the appropriate individual menu handling function is called. Note the handling of the submenu attached to the second item in the Special menu (case `mSubMenu`).

The Window menu is handled automatically by the system.

`MenuEvent` and `MenuSelect` leave the menu title highlighted if an item was actually chosen. Accordingly, the last line unhighlights the menu title when the action associated with the user's drop-down menu choice is complete.

### **doAppleApplicationMenu**

`doAppleApplicationMenu` takes the short integer representing the menu item. If this value represents the first item in the Mac OS 8/9 Apple menu or Mac OS X Application menu (the inserted "About..." item), text representing this item is drawn in the scrolling display.

If other items in the Mac OS 8/9 Apple menu are chosen, the system automatically opens the chosen object and passes control that object.

### **doFileMenu**

`doFileMenu` handles choices from the File menu when the program is run on Mac OS 8/9. In this demonstration, only the Quit item is enabled, all other items having been disabled in the File menu's 'MENU' resource. When this item is chosen, the global variable `gDone` is set to true, causing termination of the program.

### **doEditMenu**

`doEditMenu` switches according to the menu item number, drawing text representing the chosen item in the window.

### **doFontMenu**

`doFontMenu` first gets a reference to the Font menu object. This, together with the menu item number, is passed in a call to the function `GetFontFamilyFromMenuSelection`. This function returns a reference to the font family and a value representing the font style. (A font family reference represents a collection of fonts with the same design characteristics, e.g., Arial, Arial Bold, Arial Italic, and Arial Bold Italic. Font style values are, for example, 0 = plain, 1 = bold, 2 = italic, 3 = bold italic).

The font family reference and the font style value are passed in calls to `TextFont` and `TextFace`, which will cause subsequent text drawing to be conducted in the specified font and style. The call to `GetFontName` gets the font's name from the font family reference and the function `drawItemString` draws that name in the window.

The remaining code is mainly concerned with checkmarking the newly chosen Font menu item and submenu item, and unchecking the previously chosen items.

If the menu ID represents the Font menu (meaning that a menu item without an attached submenu was chosen), the previously chosen item is unchecked, a global variable stores the item number of the newly-chosen item preparatory to the next call to `doFontMenu`, and the newly chosen item is checked. If a submenu item has previously been chosen, and thus checked, it is unchecked.

If, on the other hand, the `menuID` represents one of the Font menu's submenus:

- If a submenu item has previously been chosen, that item is unchecked. A reference to the submenu object is assigned to a global variable, the menu item number is stored in another global variable preparatory to the next call to `doFontMenu`, and the newly chosen submenu item is checked.
- The next two lines uncheck the previously checked Font menu item.
- The for loop walks the Font menu looking for a match between item names and the font name previously extracted from the font family reference. When a match is found, the loop exits, the loop variable containing the item number where the match was found. This is stored in a global variable preparatory to the next call to `doFontMenu`, and is also passed in the call to `CheckMenuItem` to check that item.
- The last block gets the style name from the menu object and draws that next to the font name in the window.

### **doSizeMenu**

`doSizeMenu` switches according to the menu item chosen in the Size menu, sets the text size for all text drawing to that size, unchecks the current size item, and checks the newly chosen item. `gCurrentSize` is then set to the chosen menu item number before the function returns.

### **doSpecialMenu**

`doSpecialMenu` handles a choice of the first item in the Special menu. Since the second item is the title of a submenu, only the first item is attended to in this function.

### **doSubMenus**

`doSubMenus` switches according to the chosen item in the submenu attached to the second menu item in the Special menu.

### **drawItemString**

The function `drawItemString` is incidental to the demonstration, being called by the menu selection handling functions to draw text in the application's window to reflect the user's menu choices.

## **Demonstration Program Menus2 Listing**

```
// *****
// Menus2.c                                     CLASSIC EVENT MODEL
// *****
//
// This program is based on Menus1. The basic differences between this program and Menus1 are
// as follows:
//
// · 'xmenu' resources are used to extend the 'MENU' resources for some menus.
//
```



```
// • Extended modifier keys (Shift, Option, and Control) are used to extend the Command-key
// equivalents for two menu items in the Style menus.
//
// • There are two Style menus (Style ('xmnu') and Style (Programmatic). The two Style menus
// are intended to demonstrate assigning extended modifier keys to a menu item (1) via an
// 'xmnu' resource and (2) programmatically.
//
// • Command IDs are assigned to all menu items except those in the system-managed menus and
// the Font menu, and the associated menu handling code branches according to the command
// ID of the chosen menu item (as opposed to menu ID and menu item).
//
// • The Font menu is non-hierarchical. It is also WYSIWYG, meaning that each item is drawn
// in that font.
//
// • The delete-to-the-left, delete-to-the-right, page-up, and page-down keys are assigned as
// Command-key equivalents in the Size menu, and the glyphs are adjusted where necessary.
//
// • The submenu is attached to the second item in the Special menu programmatically rather
// than via the 'MENU' resource.
//
// • Color icons are included in the menu items in the submenu.
//
// • Balloon help is provided, via 'hmnv' resources, for all menus.
//
// The extended modifier keys in the Style ('xmnu') menu are assigned via the 'xmnu' resource
// for that menu. The extended modifier keys in the Style (Programmatic) menu are assigned
// programmatically .
//
// The command IDs for items in the File, Edit, and Style ('xmnu') menus are assigned via the
// 'xmnu' resources for those menus. The command IDs for the items in the Style
// (Programmatic), Size, and Special menus, and the submenu, are assigned programmatically.
//
// The color icon in the first submenu item is assigned via the 'MENU' resource. The color
// icon in the second item is assigned programmatically via a call to
// SetMenuItemIconHandle.
//
// The program utilises the following resources:
//
// • A 'plst' resource.
//
// • A 'WIND' resource (purgeable) (initially not visible).
//
// • An 'MBAR' resource (preload, non-purgeable).
//
// • 'MENU' resources for the drop-down menus and submenu (all preload, all non-purgeable).
//
// • 'xmnu' resources (preload, purgeable) for the drop-down menus (except the system-managed
// menus and the Font menu) and the submenu.
//
// • 'hmnv' resources (purgeable) providing balloon help for menus and menu items.
//
// • Two 'cicn' resources (purgeable) for the items in the submenu.
//
// • A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
// doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
```

```
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenuBar          128
#define mAppleApplication 128
#define mFile             129
#define iQuit             12
#define mFont             131
#define mStyleXmnu        132
#define mStyleProg        133
#define iPlain            1
#define iBold             3
#define iItalic           4
#define iOutline          6
#define iUnderline        5
#define iShadow           7
#define mSize             134
#define iTen              1
#define iTwelve           2
#define iEighteen         3
#define iTwentyFour       4
#define mSpecial          135
#define iFirst            1
#define iSecond           2
#define mSubmenu          136
#define iBat              1
#define iBowl             2
#define rWindowResource   128
#define rColorIcon        258

// ..... global variables

Boolean      gRunningOnX      = false;
Boolean      gDone;
MenuItemIndex gCurrentFontMenuItem = 0;
Style        gCurrentStyle    = 0;
MenuItemIndex gCurrentSizeMenuItem = 2;

// ..... function prototypes

void main                (void);
void doPreliminaries     (void);
OSErr quitAppEventHandler (AppleEvent *,AppleEvent *,SInt32);
void doGetMenus          (void);
void doEvents            (EventRecord *);
void doMouseDown         (EventRecord *);
void doAdjustMenus       (void);
void doMenuChoice        (SInt32);
void doCommand           (MenuCommand);
```

```

void doFontMenu          (MenuItemIndex);
void doCheckStyleMenuItem (MenuID);
void doCheckSizeMenuItem (MenuItemIndex);
void drawItemString      (Str255);

// ***** main

void main(void)
{
    EventRecord eventStructure;
    WindowRef   windowRef;
    RGBColor    foreColor = { 0xFFFF,0xFFFF,0xFFFF };
    RGBColor    backColor = { 0x4444,0x4444,0x9999 };
    Rect        portRect;

    // ..... do preliminaries

    doPreliminaries();

    // ..... open a window

    if(!(windowRef = GetNewCWindow(rWindowResource,NULL,(WindowRef) -1)))
    {
        SysBeep(10);
        ExitToShell();
    }

    SetPortWindowPort(windowRef);
    TextSize(10);
    RGBBackColor(&backColor);
    RGBForeColor(&foreColor);

    // ..... set up menu bar and menus, then show window

    doGetMenus();
    ShowWindow(windowRef);
    GetWindowPortBounds(windowRef,&portRect);
    EraseRect(&portRect);

    // ..... event loop

    gDone = false;

    while(!gDone)
    {
        if(WaitNextEvent(everyEvent,&eventStructure,180,NULL))
            doEvents(&eventStructure);
    }
}

// ***** doPreliminaries

void doPreliminaries(void)

```

```

{
    OSErr osError;

    MoreMasterPointers(32);
    InitCursor();
    FlushEvents(everyEvent,0);

    osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
                                   NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
                                   0L,false);

    if(osError != noErr)
        ExitToShell();
}

// ***** doQuitAppEvent

OSErr quitAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,SInt32 handlerRefcon)
{
    OSErr osError;
    DescType returnedType;
    Size actualSize;

    osError = AEGetAttributePtr(appEvent,keyMissedKeywordAttr,typeWildCard,&returnedType,NULL,0,
                                &actualSize);

    if(osError == errAEDescNotFound)
    {
        gDone = true;
        osError = noErr;
    }
    else if(osError == noErr)
        osError = errAEParamMissed;

    return osError;
}

// ***** doGetMenus

void doGetMenus(void)
{
    MenuBarHandle menubarHdl;
    SInt32 response;
    MenuRef menuRef;
    OSStatus osError;
    ItemCount hierMenuCount;
    SInt16 a, numberOfItems, fontNumber;
    Str255 fontName, smallSystemFontName;
    CIconHandle ciconHdl;

    // ..... get and set menu bar

    menubarHdl = GetNewMBar(rMmenubar);
    if(menubarHdl == NULL)
        ExitToShell();
    SetMenuBar(menubarHdl);

```

```

Gestalt(gestaltMenuMgrAttr,&response);
if(response & gestaltMenuMgrAquaLayoutMask)
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
    {
        DeleteMenuItem(menuRef,iQuit);
        DeleteMenuItem(menuRef,iQuit - 1);
        DisableMenuItem(menuRef,0);
    }

    gRunningOnX = true;
}

// ..... set up Font menu and make WYSIWYG

GetFontName(kThemeSmallSystemFont,smallSystemFontName);

menuRef = GetMenuRef(mFont);
if(menuRef != NULL)
{
    osError = CreateStandardFontMenu(menuRef,0,0,kNilOptions,&hierMenuCount);
    if(osError == noErr)
    {
        numberOfItems = CountMenuItems(menuRef);
        for(a=1;a<=numberOfItems;a++)
        {
            GetMenuItemText(menuRef,a,fontName);
            GetFNum(fontName,&fontNumber);
            SetMenuItemFontID(menuRef,a,fontNumber);

            if(EqualString(fontName,smallSystemFontName,false,false))
            {
                CheckMenuItem(menuRef,a,true);
                gCurrentFontMenuItem = a;
            }
        }
    }
    else ExitToShell();
}
else
    ExitToShell();

// ..... programmatically set the extended modifiers in Style (Programmatic) menu

menuRef = GetMenuRef(mStyleProg);
SetMenuItemModifiers(menuRef,iOutline,kMenuShiftModifier + kMenuOptionModifier
                    + kMenuControlModifier);
SetMenuItemModifiers(menuRef,iShadow,kMenuShiftModifier + kMenuOptionModifier);

// ..... insert submenu into menu list and programmatically attach it to Special menu, item 2

menuRef = GetMenu(mSubmenu);
if(menuRef != NULL)

```

```

{
    InsertMenu(menuRef,hierMenu);
    menuRef = GetMenuRef(mSpecial);
    SetMenuItemHierarchicalID(menuRef,iSecond,mSubmenu);
}
else
    ExitToShell();

// ..... programmatically set command IDs for second Style, Size, Special menus and submenu

menuRef = GetMenuRef(mStyleProg);
SetMenuItemCommandID(menuRef,iPlain,    'plai');
SetMenuItemCommandID(menuRef,iBold,     'bold');
SetMenuItemCommandID(menuRef,iItalic,   'ital');
SetMenuItemCommandID(menuRef,iUnderline, 'unde');
SetMenuItemCommandID(menuRef,iOutline,  'outl');
SetMenuItemCommandID(menuRef,iShadow,   'shad');

menuRef = GetMenuRef(mSize);
SetMenuItemCommandID(menuRef,iTen,      'ten ');
SetMenuItemCommandID(menuRef,iTwelve,   'twel');
SetMenuItemCommandID(menuRef,iEighteen, 'eigh');
SetMenuItemCommandID(menuRef,iTwentyFour, 'twen');

menuRef = GetMenuRef(mSpecial);
SetMenuItemCommandID(menuRef,iFirst,    'firs');

menuRef = GetMenuRef(mSubmenu);
SetMenuItemCommandID(menuRef,iBat,      'bat ');
SetMenuItemCommandID(menuRef,iBowl,     'bowl');

// ..... programmatically set the icon for the Bowl item in the submenu

cicnHdl = GetCIcon(rColorIcon);
SetMenuItemIconHandle(menuRef,iBowl,kMenuColorIconType,(Handle) cicnHdl);

// ..... programmatically set Command-key equivalents to Size menu items and adjust glyphs

menuRef = GetMenuRef(mSize);
SetItemCmd(menuRef,iTen,0x08);
SetMenuItemKeyGlyph(menuRef,iTen,kMenuDeleteLeftGlyph);
SetItemCmd(menuRef,iTwelve,0x7f);
SetMenuItemKeyGlyph(menuRef,iTwelve,kMenuDeleteRightGlyph);
SetItemCmd(menuRef,iEighteen,0x0b);
SetMenuItemKeyGlyph(menuRef,iEighteen,kMenuPageUpGlyph);
SetItemCmd(menuRef,iTwentyFour,0x0c);
SetMenuItemKeyGlyph(menuRef,iTwentyFour,kMenuPageDownGlyph);

// ..... programmatically exclude the mark column and set the font in the Special menu

menuRef = GetMenuRef(mSpecial);
SetMenuExcludesMarkColumn(menuRef,true);

```



```

GetFNum("\pGadget",&fontNumber);
if(fontNumber != 0)
    SetMenuFont(menuRef,fontNumber,12);

// ..... if running on Mac OS X, create Help menu and insert one item

if(gRunningOnX)
{
    HMGetHelpMenu(&menuRef,NULL);
    InsertMenuItem(menuRef,"\pMenus Help",0);
    SetMenuItemCommandID(menuRef,1,'help');
}

// ..... set initial font, style, and size, and checkmark them

doCheckStyleMenuItem(mStyleXmnu);
doCheckStyleMenuItem(mStyleProg);
doCheckSizeMenuItem(iTen);

// ..... draw menu bar

DrawMenuBar();
}

// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEProcessAppleEvent(eventStrucPtr);
            break;

        case mouseDown:
            doMouseDown(eventStrucPtr);
            break;

        case keyDown:
            if((eventStrucPtr->modifiers & cmdKey) != 0)
            {
                doAdjustMenus();
                doMenuChoice(MenuEvent(eventStrucPtr));
            }
            break;

        case updateEvt:
            BeginUpdate((WindowRef) eventStrucPtr->message);
            EndUpdate((WindowRef) eventStrucPtr->message);
            break;
    }
}

```

```
// ***** doMouseDown

void doMouseDown(EventRecord *eventStrucPtr)
{
    WindowRef      windowRef;
    WindowPartCode partCode;
    SInt32          menuChoice;

    partCode = FindWindow(eventStrucPtr->where,&windowRef);

    switch(partCode)
    {
        case inMenuBar:
            doAdjustMenus();
            menuChoice = MenuSelect(eventStrucPtr->where);
            doMenuChoice(menuChoice);
            break;

        case inContent:
            if(windowRef != FrontWindow())
                SelectWindow(windowRef);
            break;

        case inDrag:
            DragWindow(windowRef,eventStrucPtr->where,NULL);
            break;

        case inGoAway:
            if(TrackGoAway(windowRef,eventStrucPtr->where))
                gDone = true;
            break;
    }
}

// ***** doAdjustMenus

void doAdjustMenus(void)
{
    // Adjust menus here. Use EnableMenuCommand and DisableMenuCommand to enable/disable those
    // menu items with command IDs.
}

// ***** doMenuChoice

void doMenuChoice(SInt32 menuChoice)
{
    MenuID      menuID;
    MenuItemIndex menuItem;
    OSERR      osErr;
    MenuCommand commandID;

    menuID = HiWord(menuChoice);
    menuItem = LoWord(menuChoice);
```

```

if(menuID == 0)
    return;
else if(menuID == mFont)
    doFontMenu(menuItem);
else
{
    osErr = GetMenuItemCommandID(GetMenuRef(menuID),menuItem,&commandID);
    if(osErr == noErr && commandID != 0)
        doCommand(commandID);
}

HiliteMenu(0);
}

// ***** doCommand

void doCommand(MenuCommand commandID)
{
    MenuRef menuRef;

    switch(commandID)
    {
        // ..... Apple/Application menu

        case 'abou':
            drawItemString("\pAbout Menus2");
            break;

        // ..... File menu

        case 'quit':
            gDone = true;
            break;

        // ..... Edit menu

        case 'undo':
            drawItemString("\pUndo");
            break;

        case 'cut ':
            drawItemString("\pCut");
            break;

        case 'copy':
            drawItemString("\pCopy");
            break;

        case 'past':
            drawItemString("\pPaste");
            break;

        case 'clea':
            drawItemString("\pClear");
            break;
    }
}

```

```

// ..... Style ('xmnu') and Style (Programmatic) menu

case 'plai':
    gCurrentStyle = 0;
    doCheckStyleMenuItem(mStyleXmnu);
    doCheckStyleMenuItem(mStyleProg);
    break;

case 'bold':
    if(gCurrentStyle & bold)
        gCurrentStyle -= bold;
    else
        gCurrentStyle |= bold;
    doCheckStyleMenuItem(mStyleXmnu);
    doCheckStyleMenuItem(mStyleProg);
    break;

case 'ital':
    if(gCurrentStyle & italic)
        gCurrentStyle -= italic;
    else
        gCurrentStyle |= italic;
    doCheckStyleMenuItem(mStyleXmnu);
    doCheckStyleMenuItem(mStyleProg);
    break;

case 'unde':
    if(gCurrentStyle & underline)
        gCurrentStyle -= underline;
    else
        gCurrentStyle |= underline;
    doCheckStyleMenuItem(mStyleXmnu);
    doCheckStyleMenuItem(mStyleProg);
    break;

case 'outl':
    if(gCurrentStyle & outline)
        gCurrentStyle -= outline;
    else
        gCurrentStyle |= outline;
    doCheckStyleMenuItem(mStyleXmnu);
    doCheckStyleMenuItem(mStyleProg);
    break;

case 'shad':
    if(gCurrentStyle & shadow)
        gCurrentStyle -= shadow;
    else
        gCurrentStyle |= shadow;
    doCheckStyleMenuItem(mStyleXmnu);
    doCheckStyleMenuItem(mStyleProg);
    break;

```

```

// ..... Size menu

case 'ten':
    TextSize(10);
    doCheckSizeMenuItem(iTen);
    break;

case 'twel':
    TextSize(12);
    doCheckSizeMenuItem(iTwelve);
    break;

case 'eigh':
    TextSize(18);
    doCheckSizeMenuItem(iEighteen);
    break;

case 'twen':
    TextSize(24);
    doCheckSizeMenuItem(iTwentyFour);
    break;

// ..... Special menu

case 'firs':
    drawItemString("\pFirst Item");
    break;

// ..... submenu

case 'bat ':
    menuRef = GetMenuRef(mSubmenu);
    DisableMenuItem(menuRef, iBat);
    EnableMenuItem(menuRef, iBowl);
    drawItemString("\pBat");
    break;

case 'bowl':
    menuRef = GetMenuRef(mSubmenu);
    DisableMenuItem(menuRef, iBowl);
    EnableMenuItem(menuRef, iBat);
    drawItemString("\pBowl");
    break;

case 'help':
    AHGotoPage(CFSTR("Menus Help"), CFSTR("Menus.htm"), NULL);
    break;
}
}

```

```
// ***** doFontMenu

void doFontMenu(MenuItemIndex menuItem)
{
    MenuRef      menuRef;
    OSStatus     osError;
    FMFontFamily currentFontFamilyReference;
    FMFontStyle  fontStyle;
    Str255       fontName;

    menuRef = GetMenuRef(mFont);

    osError = GetFontFamilyFromMenuSelection(menuRef,menuItem,&currentFontFamilyReference,
                                             &fontStyle);

    if(osError == noErr || osError == menuPropertyNotFoundErr)
    {
        TextFont(currentFontFamilyReference);

        CheckMenuItem(menuRef,gCurrentFontMenuItem,false);
        gCurrentFontMenuItem = menuItem;
        CheckMenuItem(menuRef,gCurrentFontMenuItem,true);

        GetMenuItemText(menuRef,menuItem,fontName);
        drawItemString(fontName);
    }
    else
        ExitToShell();
}

// ***** doCheckStyleMenuItem

void doCheckStyleMenuItem(MenuID menuID)
{
    MenuRef      styleMenuRef;
    static Boolean stringAlreadyDrawnOnce = false;

    styleMenuRef = GetMenuRef(menuID);

    CheckMenuItem(styleMenuRef,iPlain,    gCurrentStyle == 0);
    CheckMenuItem(styleMenuRef,iBold,     gCurrentStyle & bold);
    CheckMenuItem(styleMenuRef,iItalic,   gCurrentStyle & italic);
    CheckMenuItem(styleMenuRef,iUnderline,gCurrentStyle & underline);
    CheckMenuItem(styleMenuRef,iOutline,  gCurrentStyle & outline);
    CheckMenuItem(styleMenuRef,iShadow,   gCurrentStyle & shadow);

    TextFace(gCurrentStyle);

    if(!stringAlreadyDrawnOnce)
        drawItemString("\pStyle change");

    stringAlreadyDrawnOnce = !stringAlreadyDrawnOnce;
}
```



```
// ***** doCheckSizeMenuItem

void doCheckSizeMenuItem(MenuBarItem menuItem)
{
    MenuRef sizeMenuRef;

    sizeMenuRef = GetMenuRef(mSize);

    CheckMenuItem(sizeMenuRef,gCurrentSizeMenuItem,false);
    CheckMenuItem(sizeMenuRef,menuItem,true);

    gCurrentSizeMenuItem = menuItem;

    drawItemString("\pSize change");
}

// ***** drawItemString

void drawItemString(Str255 eventString)
{
    RgnHandle tempRegion;
    WindowRef windowRef;
    Rect scrollBox;

    windowRef = FrontWindow();
    tempRegion = NewRgn();

    GetWindowPortBounds(windowRef,&scrollBox);

    ScrollRect(&scrollBox,0,-30,tempRegion);
    DisposeRgn(tempRegion);

    MoveTo(8,286);
    DrawString(eventString);
}

// *****
```

## Demonstration Program Menus2 Comments

When this program is run, the user should choose Show Balloons from the Help menu and make menu choices from all menus, including the Apple menu. Choices should be made using the mouse and, where appropriate, the keyboard equivalents. The user should note:

- The extended modifier keys assigned to the last two items in the Style menus.
- The Command-key equivalents assigned to the items in the Size menu. (These are, in order, delete-to-the-left key, delete-to-the-right key, page-up key, and page-down key.)
- That the Font menu is WYSIWYG.
- That the marking character column has been deleted from the Special menu and the menu items in this menu are drawn in the Gadget font (assuming it is available).

- That the items in the submenu attached to the second item in the Special menu have color icons.
- The balloon help provided for all menus and menu items.

The Menus2 demonstration program package also includes a demonstration of Apple Help, including the methodology used to create an item in the Mac OS 8/9 Help menu. The Apple Guide file titled "Menus Guide", which will cause a "Menus Help" item to be created in the Mac OS 8/9 Help menu, should be retained in the same folder as the Menus2 application. An alias of the folder titled "Menus Help" should be placed in the Help folder in the System Folder (Mac OS 8/9) and in the user's Help folder (~Library/Documentation/Help) (Mac OS X). You will then be able to access the help content by choosing Menus Help from the Help menu.

The help content does not provide user assistance for Menus2 programs as such. Rather, it provides a brief description of how to provide user assistance for your application using Apple Help.

Because this demonstration program is based on Menus1, the following comments exclude those for the functions that remain unchanged.

### **main**

The calls to `RGBBackColor` and `RGBForeColor` set the window background and foreground colors to, respectively, dark blue and white.

### **doGetMenus**

`doGetMenus` sets up the menu bar and the various menus.

`GetNewMBar` reads in the 'MENU' resources for each menu specified in the 'MBar' resource and creates a menu object for each of those menus. (Note that the error handling here and in other areas of this program is somewhat rudimentary: the program simply terminates.) `SetMenuBar` makes the newly created menu list the current list.

The next block utilizes the Menu Manager function `CreateStandardFontMenu` in the creation of a non-hierarchical Font menu. Following the call to `CreateStandardFontMenu`, the process of making the menu WYSIWYG begins. The call to `CountMenuItems` returns the number of items in the menu. Then, for each of these items, `GetMenuItemText` gets the font's name, `GetFNum` gets the font number associated with the font name, and `SetMenuItemFontID` sets the font for the menu item. In the following if block, the current item is checkmarked if the item name equals the name of the small system font, and the global variable which keeps track of the currently selected font is assigned the item number.

The next block programmatically assigns extended modifier keys to the Outline and Shadow items in the Style (Programmatic) menu. The `SetMenuItemModifiers` calls assign Shift-Option-Control to the Outline item and Shift-Option to the Shadow item. (The extended modifier keys for the same two items in the Style ('xmnu') menu are assigned in the associated 'xmnu' resources.)

The next block inserts the application's single submenu into the submenu portion of the menu list and programmatically attaches it to the Special menu's second menu item. `GetNewMBar` does not read in the resource descriptions of submenus, so the first step is to read in the 'MENU' resource with `GetMenu`. `InsertMenu` inserts a menu object for this menu into the menu list at the location specified in the second parameter to this call. (Using the constant `hierMenu (-1)` as the second parameter causes the menu to be installed in the submenu portion of the menu list.) The call to `GetMenuRef` gets a reference to the Special menu, which is used in the following call to `SetMenuHierarchicalID` to attach the submenu to the second item in the Special menu.

The following rather large block programmatically assigns command IDs to all items in the Style (Programmatic), Size, and Special menus and the submenu. (Command IDs for the File and Style ('xmnu') menus are assigned in the associated 'xmnu' resources. It is not possible to assign command IDs to the items in the Font menu.) The Command IDs are defined in the four-character-code format, which packs four one-byte characters together in a 32-bit value. For example, 'plai' expressed as hexadecimal is 0x706C6169. 70 is the ASCII code for p, 6C is the ASCII code for l, and 69 is the ASCII code for i.

The following block programmatically assigns a color icon to the second item in the submenu. The call to `GetCIcon` creates a `CIcon` data structure and initializes it from data read in from the specified 'cicon' resource. The handle to this structure is then passed as the last parameter in the `SetMenuItemIconHandle`, the third parameter specifying that the type of icon is a color icon. (The color icon for the first item in the submenu is assigned in the associated 'xmnu' resource.)

The next block programmatically assigns command-key equivalents to the items of the Size menu. (Because the keys assigned are the two delete keys and the page-up and page-down keys, it is not possible to make these assignments within the 'MENU' resource.) Also, a substitute glyph must be assigned, otherwise the correct glyphs will not be displayed. The calls to `SetItemCmd` assign the specified key to the menu item, and a substitute glyph is assigned via calls to `SetMenuItemGlyph`. If this is not done, the glyphs displayed will not be the correct visual representations of the keys. (These substitute glyphs could also have been specified in the keyboard glyph fields for these items in the menu's 'xmnu' resource.)

In the next block, `SetMenuExcludesMarkColumn` is called to delete the marking character column from the Special menu and `SetMenuFont` is called to set the font for the menu items in this menu to Gadget (assuming that font is present).

In the next block, and only if the program is running on Mac OS X, `HMGetHelpMenu` is called to create a Help menu, `InsertMenuItem` is called to insert a single item in that menu, and `SetMenuItemCommandID` assigns a command ID to that item.

The next block sets checkmarks against the appropriate font, style and size menu items according to the initialized values of the associated global variables.

The call to `DrawMenuBar` draws the menu bar

Note that, in Carbon, the contents of the Apple Menu Items folder are automatically added to the Apple menu.

### **doMenuChoice**

`doMenuChoice` extracts the menu ID and menu item number from the long integer returned by the `MenuSelect` and `MenuEvent` calls. An immediate return is made if the high word equals 0. The function “special cases” the Font menus, calling the function for handling choices from that menu. Otherwise, `GetMenuItemCommandID` is called. `GetMenuItemCommandID` returns zero as the function result if the call is successful, and a pointer to an integer representing the value of the item’s command ID will be returned in the third parameter. If the call is successful, and if a zero is not returned in the third parameter, a command ID exists for the item. Accordingly, the command ID is passed in a call to the function `doCommand`.

`MenuSelect` and `MenuEvent` leave the menu title highlighted if an item was actually chosen. Accordingly, the last line unhighlights the menu title when the action associated with the user’s drop-down menu choice is complete.

### **doCommand**

`doCommand` handles choices from those menus whose items have command IDs.

Note that the initial handling of all of the remaining menu items, regardless of which menu they belong to, is attended to within the one switch in the one function. The responses to the user choosing the various menu items is the same as in `Menus1`, except that the code relating to checkmarking the Style menu items has been added and the code for checkmarking the Size menu items and storing the current size has been divided between this function a further handling function (`doCheckSizeMenuItem`).

At the block titled Style ('xmnu') and Style (Programmatic) menu, bits in the global variable `gCurrentStyle` are set or unset according to the font styles selected. The code reflects the fact that Bold, Italic, Underline, Outline and Shadow style selections are additive, not mutually exclusive, and that a selection of Plain must unset all bits in `gCurrentStyle`. The code also reflects the requirement that, except in the case of the Plain item, the selection of a checked item must cause that item to be unchecked, and vice versa. With `gCurrentStyle` set, the function `doCheckStyleMenuItem` is called to check/uncheck the relevant menu items as appropriate.

Note that the handling of the two submenu items has been changed to make the items mutually exclusive.

The ‘help’ command ID case applies only when the program is run on Mac OS X. The function `AHGoToPage` is called to deliver a request to load the specified HTML file in the specified Help book folder to the Help Viewer application.

### **doCheckStyleMenuItem**

`doCheckStyleMenuItem` is called from `doMenuChoice` when an item in the Style menu is chosen. With the appropriate bit settings of `gCurrentStyle` attended to within `doMenuChoice`, a reference to the Style menu object is obtained. This is required for the six `CheckMenuItem` calls, which check or uncheck the individual menu items according to whether the third parameter evaluates to, respectively, true or false.

The call to `TextFace` sets the style for subsequent text drawing. The last line draws some text to prove that the desired effect was achieved.





# Introduction to Windows

## CHAPTER

# 4

### IN THIS CHAPTER

- Scope of This Chapter 156
- Window Basics 156
- Types of Windows 158
- Window Regions 164
- Controls and Control Lists 167
- The Window List 168
- The Graphics Port and the Window Object 168
- Events in Windows 171
- Creating Your Application's Windows 171
- Managing Multiple Windows and Associated Data 176
- Handling Events 177
- Manipulating Windows 180
- Providing Help Balloons (Mac OS 8/9) 184
- Main Window Manager Constants, Data Types, and Functions 187
- Demonstration Program Windows1 Listing 190
- Demonstration Program Windows1 Comments 202

## Scope of This Chapter

On Mac OS 8/9, Mac OS 8.5 introduced a number of significant new features and associated system software functions to the Window Manager. This chapter limits itself to the Window Manager as it existed prior to Mac OS 8.5, as influenced by the Carbon API. The additional features introduced with Mac OS 8.5 and Carbon are addressed in Chapter 16.

### NOTE

By definition, all new functions introduced with Mac OS 8.5 and later are automatically supported by Carbon.

## Window Basics

### Windows, Documents, the Window Manager and Graphics Ports

A **window** is an area on the screen in which the user can enter or view information. Macintosh applications use windows for most communications and interactions with the user, including editing documents and presenting and acknowledging alerts and dialogs.

Users generally enter data in windows and your application typically lets the user save this data to a file. Your application typically creates **document windows** for this purpose. A document window is a view into the document. If the document is larger than the window, the window is a view of a portion of the document.

The Window Manager, which provides functions for managing windows, depends on QuickDraw. QuickDraw supports drawing into **graphics ports**. Each window represents a graphics port.

### Standard Window Elements

### NOTE

In the following, Mac OS 8/9 terminology is used. **Size box** equates to **resize control**. **Zoom box** equates to **zoom button**. **Close box** equates to **close button**. **Collapse box** equates to **minimize button**.

The user can manipulate windows using a set of standard window elements supported by the Window Manager. These standard elements are as follows:

- **Title Bar.** The title bar is the bar at the top of a window that displays the window's name, contains the close, zoom, and collapse boxes, and indicates whether a window is active. The name of a newly created window with which no document is yet associated should be "untitled". The name of a window containing a saved document should be the document's filename.
- **Close Box.** The close box allows the user to close a window. The close box is sometimes called the **go-away box**.
- **Zoom Box.** The zoom box allows the user to choose between two different window sizes, one established by the user and one by the application. On Mac OS 8/9, the zoom box can be full, vertical, or horizontal.
- **Collapse Box.** The collapse box allows the user to collapse (minimize on Mac OS X) and uncollapse a window.
- **Size Box.** The size box allows the user change the size of a window.
- **Draggable Area.** That part of the window's "frame," less the close, zoom, collapse, and size boxes.

**Scroll bars**, which allow the user to view different parts of a document containing more information than can be displayed in the window at the one time, are not an integral part of a window and must be separately created and managed. By convention, scroll bars are placed on the right and lower edges of those windows that require them.

## Active and Inactive Windows

The **active window** is the window in which the user is currently working. It is identified by its general appearance (see Fig 1). All keyboard activity targets the active window and only the active window interacts with the user.

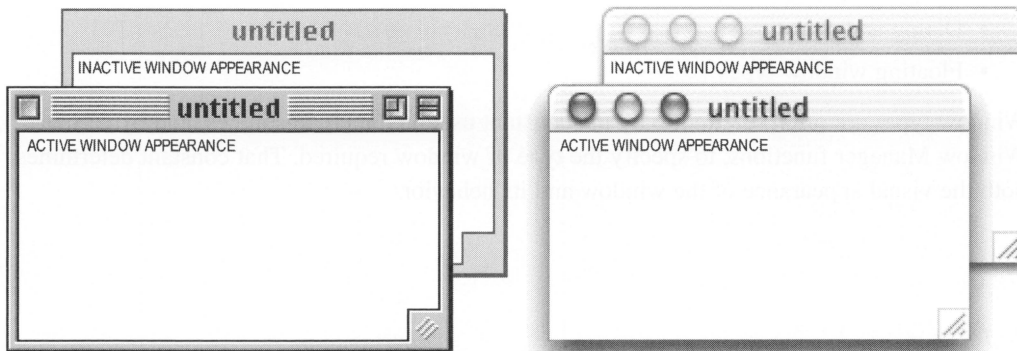


FIG 1 - APPEARANCE OF ACTIVE AND INACTIVE WINDOWS

When the user activates one of your application's windows, the Window Manager redraws the window's title bar and frame/shadow, the close box/button, the title text, the zoom box/button, the collapse box/minimize button, and the size box/resize control as shown in Fig 1. Your application must reinstate the appearance of the rest of the window to its state prior to the deactivation, activating any controls, drawing the scroll box (scroller, in Mac OS X terminology) in the same position, restoring the insertion point, and highlighting the previous selection, and so on.

When a window belonging to your application becomes **inactive**, the Window Manager redraws the title bar and frame/shadow, as shown in Fig 1. Your application must deactivate any controls, remove highlighting from selections, and so on.

When the user clicks in an inactive document window, your application should make the window active but should not make any selections in response to the click. To make a selection, the user should be required to click again. This behavior protects the user from unintentionally losing an existing selection when activating the window.

## Window Layering

On Mac OS 8/9, all of an application's document windows are in the one layer. On Mac OS X, document windows from different applications can be interleaved, and clicking on a window to bring it forward does not affect the layering of other windows. That said, if an application has a Window menu, choosing Bring All To Front will cause all of the application's document windows to be brought in front of all of the document windows of all other applications. Clicking on the application's icon in the Dock has the same effect.

## Types of Windows

The Window Manager defines a large number of window **types**, which may be classified as follows:

- Document types
- Dialog and alert types
- Floating window types

Window types are often referred to by the constant used in 'WIND' resources, and by certain Window Manager functions, to specify the type of window required. That constant determines both the visual appearance of the window and its behavior.

## Document Types

Fig 2 shows the eight available window types for documents and the constants that represent those types.

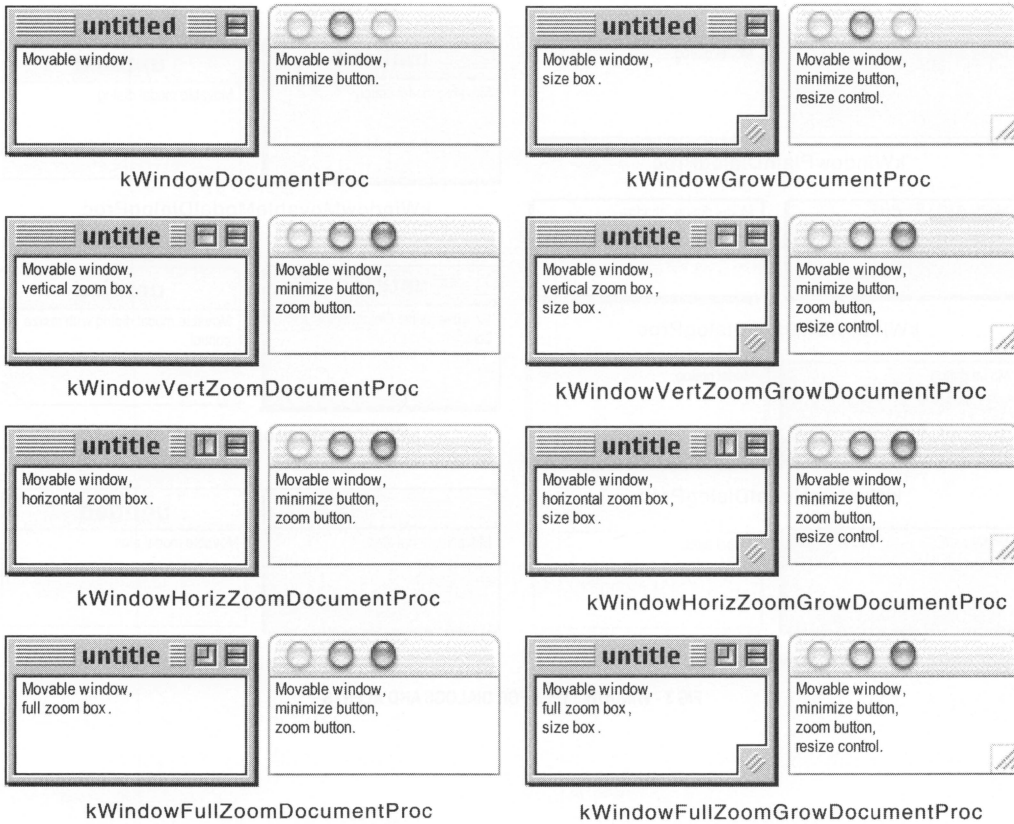


FIG 2 - WINDOW TYPES FOR DOCUMENTS

## Dialog and Alert Types

Fig 3 shows the seven available window types for modal and movable modal dialogs and alerts and the constants that represent those types. (The document window type represented by the constant `kWindowDocumentProc` is used for modeless dialogs.)



FIG 3 - WINDOW TYPES FOR DIALOGS AND ALERTS



# Floating Window Types

Figs 4 and 5 show the sixteen available window types for floating windows and the constants that represent those types.



FIG 4 - WINDOW TYPES FOR FLOATING WINDOWS (TITLE BAR AT TOP)



FIG 5 - WINDOW TYPES FOR FLOATING WINDOWS (PSUEDO TITLE BAR AT SIDE)

## Window Definition IDs

The constants shown in Figs 2, 3, 4, and 5 each represent a specific **window definition ID**. A window definition ID is a 16-bit value which contains the resource ID of the window's **window definition function** in the upper 12 bits and a **variation code** in the lower 4 bits:

- **Window Definition Function.** The system software and various Window Manager functions call a window's window definition function (WDEF) when they need to perform certain window-related actions, such as drawing or re-sizing a window's frame.
- **Variation Code.** A single WDEF can support up to 16 different window types. The WDEF defines a variation code—an integer from 0 to 15—for each window type it supports.

Four WDEFs (resource IDs 64, 65, 66, and 67) are associated with the three classifications of window types.

The window definition ID is derived by multiplying the resource ID of the WDEF by 16 and adding the variation code to the result, as is shown in the following:

<i>WDEF Resource ID</i>	<i>Variation Code</i>	<i>Window Definition ID (Value)</i>	<i>Window Definition ID (Constant)</i>
64	0	$64 * 16 + 0 = 1024$	kWindowDocumentProc
64	1	$64 * 16 + 1 = 1025$	kWindowGrowDocumentProc
64	2	$64 * 16 + 2 = 1026$	kWindowVertZoomDocumentProc
64	3	$64 * 16 + 3 = 1027$	kWindowVertZoomGrowDocumentProc
64	4	$64 * 16 + 4 = 1028$	kWindowHorizZoomDocumentProc
64	5	$64 * 16 + 5 = 1029$	kWindowHorizZoomGrowDocumentProc
64	6	$64 * 16 + 6 = 1030$	kWindowFullZoomDocumentProc
64	7	$64 * 16 + 7 = 1031$	kWindowFullZoomGrowDocumentProc
65	0	$65 * 16 + 0 = 1040$	kWindowPlainDialogProc
65	1	$65 * 16 + 1 = 1041$	kWindowShadowDialogProc
65	2	$65 * 16 + 2 = 1042$	kWindowModalDialogProc
65	3	$65 * 16 + 3 = 1043$	kWindowMovableModalDialogProc
65	4	$65 * 16 + 4 = 1044$	kWindowAlertProc
65	5	$65 * 16 + 5 = 1045$	kWindowMovableAlertProc
65	6	$65 * 16 + 6 = 1046$	kWindowMovableModalGrowProc
66	1	$66 * 16 + 1 = 1057$	kWindowFloatProc
66	3	$66 * 16 + 3 = 1059$	kWindowFloatGrowProc
66	5	$66 * 16 + 5 = 1061$	kWindowFloatVertZoomProc
66	7	$66 * 16 + 7 = 1063$	kWindowFloatVertZoomGrowProc
66	9	$66 * 16 + 9 = 1065$	kWindowFloatHorizZoomProc
66	11	$66 * 16 + 11 = 1067$	kWindowFloatHorizZoomGrowProc
66	13	$66 * 16 + 13 = 1069$	kWindowFloatFullZoomProc
66	15	$66 * 16 + 15 = 1071$	kWindowFloatFullZoomGrowProc
67	1	$67 * 16 + 1 = 1073$	kWindowFloatSideProc
67	3	$67 * 16 + 3 = 1075$	kWindowFloatSideGrowProc
67	5	$67 * 16 + 5 = 1077$	kWindowFloatSideVertZoomProc
67	7	$67 * 16 + 7 = 1079$	kWindowFloatSideVertZoomGrowProc
67	9	$67 * 16 + 9 = 1081$	kWindowFloatSideHorizZoomProc
67	11	$67 * 16 + 11 = 1083$	kWindowFloatSideHorizZoomGrowProc
67	13	$67 * 16 + 13 = 1085$	kWindowFloatSideFullZoomProc
67	15	$67 * 16 + 15 = 1087$	kWindowFloatSideFullZoomGrowProc

## Window Type Usage

### For Documents

A `kWindowFullZoomGrowDocumentProc` window is normally used for document windows because it supports all window manipulation elements. Note that because you can optionally suppress the close box/button when you create the window, the Window Manager does not necessarily draw/highlight that particular element. Also note that when the related document contains more data than will fit in the window, you must add scroll bars.

### For Modal Alerts and Modal Dialogs

Modal alerts and modal dialogs are simply special-purpose windows. Modal alerts generally use the window type `kWindowAlertProc` and modal dialogs generally use window type `kWindowModalDialogProc`.

#### NOTE

The creation and handling of alerts and dialogs is addressed in detail in Chapter 8.

### For Movable Modal Alerts and Movable Modal Dialogs

Movable modal alerts and movable modal dialogs are used when you want the user to be able to move the alert or dialog window or to bring another application to the foreground before the dialog is dismissed. Movable modal alerts use the window type `kWindowMovableAlertProc` and movable modal dialogs use the window type `kWindowMovableModalDialogProc`.

### For Modeless Dialogs

Modeless dialogs allow the user to perform other tasks within the application without first dismissing the dialog. User interface guidelines require that the `kWindowDocumentProc` window type, which can be moved or closed but not resized or zoomed, be used for modeless dialogs.

## Window Regions

The Window Manager recognizes the special-purpose **regions** shown in Figs 6 and 7.

NOTE

A region is an arbitrary area, or set of areas, on the QuickDraw coordinate plane. The outline of a region is one or more closed loops. Regions are explained in more detail in Chapter 12.

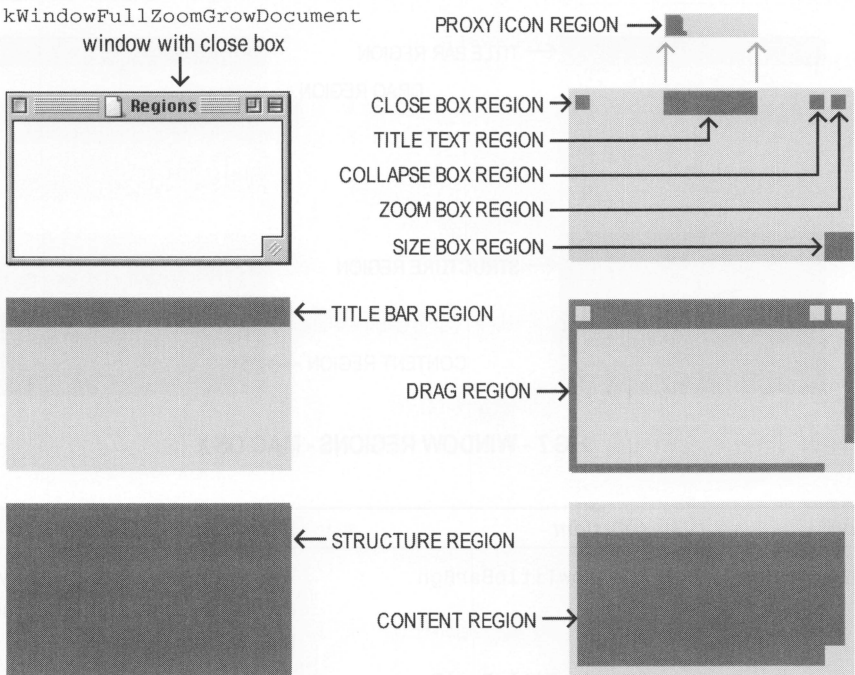


FIG 6 - WINDOW REGIONS - MAC OS 8/9

Handles to these and two other window-related regions, which are represented by constants of type `RegionWindowCode`, may be obtained via a call to `GetWindowRegion`. The definitions of these regions, and the constants which represent them, are as follows:

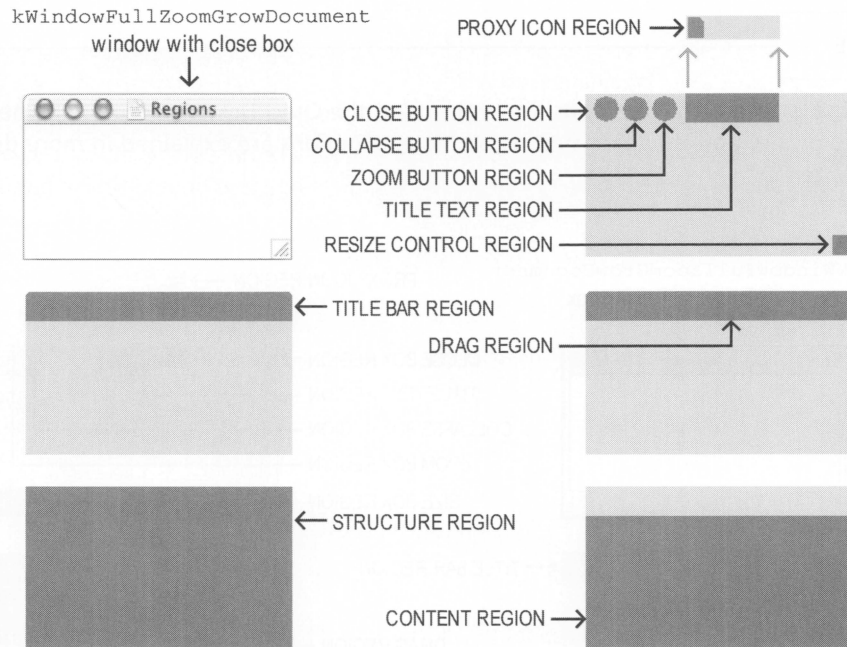


FIG 7 - WINDOW REGIONS - MAC OS X

Region	Constant	Definition
Title bar region	kWindowTitleBarRgn	The entire area occupied by a window's title bar, including the title text region.
Title text region	kWindowTitleTextRgn	That portion of a window's title bar that is occupied by the name of the window and the window proxy icon. (See Chapter 16.)
Close box/button region	kWindowCloseBoxRgn	The area occupied by a window's close box/button.
Zoom box/button region	kWindowZoomBoxRgn	The area occupied by a window's zoom box/button.
Drag region	kWindowDragRgn	On Mac OS X, this equates to the title bar region. On Mac OS 8/9, this includes the window frame, including the title bar and window outline, but excluding the close box, zoom box, collapse box, and size box (if any).



<i>Region</i>	<i>Constant</i>	<i>Definition</i>
Size box/resize control region	kWindowGrowRgn	The area occupied by a window's size box/resize control.
Collapse box/minimize button region	kWindowCollapseBoxRgn	The area occupied by a window's collapse box/minimize button.
Proxy icon region	kWindowTitleProxyIconRgn	The area occupied by the window proxy icon. (See Chapter 16.)
Structure region	kWindowStructureRgn	The entire area occupied by a window, including the frame and content region. (The window may be partially off-screen but its structure region does not change.)
Content region	kWindowContentRgn	That part of a window in which the contents of a document and the window's controls (including scroll bars) are displayed.
Update region	kWindowUpdateRgn	Contains all areas of a window's content region that need updating (re-drawing).
Global port region	kWindowGlobalPortRgn	The bounds of the window's graphics port, in global coordinates, even when the window is collapsed.

## The Desktop (Gray) Region

Another region of some relevance to the Window Manager is the **desktop region** (sometimes known as the **gray region**). The desktop region is the region below the menu bar, including all screen real estate in a system equipped with multiple monitors. The Window Manager maintains a pointer to the desktop region in a low-memory global variable named `GrayRgn`. You can get a handle to the desktop region using the function `GetGrayRgn`.

## Controls and Control Lists

Windows may contain **controls**. The most common control in a window is the **scroll bar** (see Fig 8), which should be included in the window when there is more data than can be shown at one time in the space available. The Control Manager is used to create, display and manipulate scroll bars.

All controls “belonging” to an individual window and are displayed within the graphics port that represents that window. Entries pointing to the descriptions of a window’s controls are stored in a **control list** maintained for that window by the Window Manager.

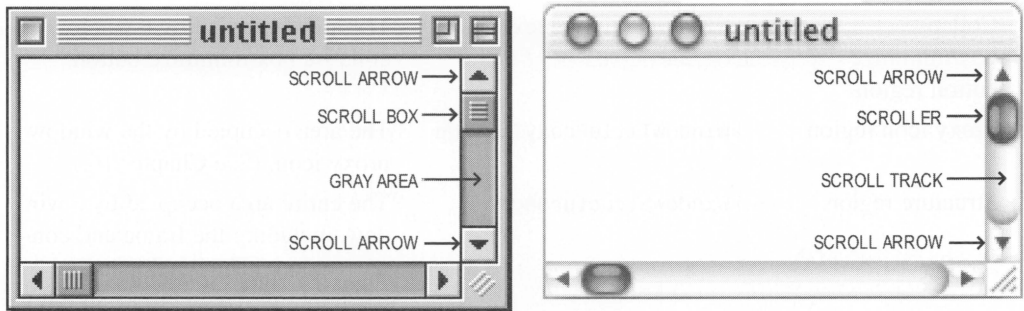


FIG 8 - SCROLL BARS

## The Window List

At any one time, many windows, from many applications, may be displayed on the desktop. To track all of the windows on the desktop, the Window Manager maintains a private data structure called the **window list**. The arrangement of the entries in this list reflects the current front-to-back ordering of the windows on the desktop, the frontmost (active) window being the first in the list.

The function `GetWindowList` returns a reference to the window object (see below) for the first window in the window list. The function `GetNextWindow` returns a reference to the window object for the next window in the window list.

## The Graphics Port and the Window Object

### The Graphics Port

Each window represents a QuickDraw graphics port, an opaque object of type `CGrafPort` which describes a drawing environment with its own coordinate system. The Window Manager creates a graphics port when it creates the window.

#### NOTE

The graphics port is addressed in detail in Chapter 11.

The location of a window on the screen is defined in QuickDraw's **global coordinates**. QuickDraw's global coordinates originate at the top left corner of the main screen and extend vertically and horizontally within the range  $-32768$  to  $32,767$ . The positive x-axis extends rightward and the positive y-axis extends downward (see Fig 9).

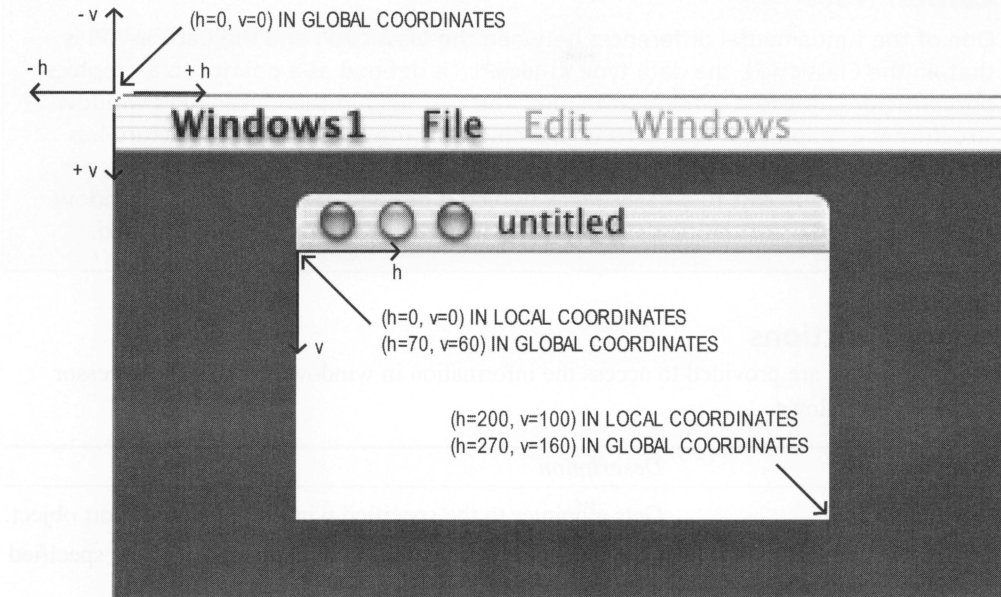


FIG 9 - A WINDOW'S LOCAL AND GLOBAL COORDINATE SYSTEMS

The graphics port object stores a rectangle called the **port rectangle**. In a graphics port representing a window, the port rectangle represents the window's content region. Within the port rectangle, the drawing area is described in **local coordinates**. Fig 9 illustrates the local and global coordinate systems for a window which is 100 pixels high by 200 pixels wide, and which is placed with its content region 70 pixels down and 60 pixels to the right of the upper-left corner of the screen.

When the Window Manager creates a window, it places the origin of the local coordinate system at the upper-left corner of the window's port rectangle. Note, however, that the Event Manager describes mouse events in global coordinates, and that you must do most of your window manipulation in global coordinates.

## The Window Object

The Window Manager stores information about individual windows in opaque data structures called **window objects**. The data type `WindowPtr` is defined as a pointer to a window object:

```
typedef struct OpaqueWindowPtr* WindowPtr;
```

Note that the data type `WindowPtr` is equivalent to the newer data type `WindowRef`:

```
typedef WindowPtr WindowRef;
```

### Carbon Note

One of the fundamental differences between the Classic API and the Carbon API is that, in the Classic API, the data type `WindowPtr` is defined as a pointer to a graphics port structure, not to a window structure. The first field in the Classic API's window structure is a graphics port structure, meaning that the graphics port structure has the same address as the window structure in which it resides. In the Classic API, a `WindowPtr` must be cast to a `WindowPeek` (which is defined as a pointer to a window structure) in order for the fields of the window structure to be directly accessed.

## Accessor Functions

Accessor functions are provided to access the information in window objects. The accessor functions are as follows:

<i>Function</i>	<i>Description</i>
<code>GetWindowPort</code>	Gets a pointer to the specified window's graphics port object.
<code>GetWindowKind</code>	Gets the window kind (dialog or application) of the specified window.
<code>SetWindowKind</code>	Sets the window kind (dialog or application) of the specified window.
<code>IsWindowVisible</code>	Determines whether the specified window is visible.
<code>ShowWindow</code>	Makes the specified window visible.
<code>HideWindow</code>	Makes the specified window invisible.
<code>ShowHide</code>	Makes the specified window visible or invisible without affecting front-to-back ordering.
<code>IsWindowHilited</code>	Determines whether the specified window is highlighted.
<code>HiliteWindow</code>	Highlights or unhighlights a window.
<code>GetWindowRegion</code>	Gets a handle to the specified window's structure, content, and update regions.  <b>Note:</b> Handles to the other regions shown in Figs 6 and 7 are not included in the window object. The WDEF determines the location of those particular regions.
<code>GetWTitle</code>	Gets the specified window's title.
<code>SetWTitle</code>	Sets the specified window's title.

<i>Function</i>	<i>Description</i>
GetWindowPic	Gets a handle to the picture stored in the window object by SetWindowPic.
SetWindowPic	Stores a handle to a picture in the window object, causing the Window Manager to draw the picture instead of generating an update event.
GetWRefCon	Gets the reference constant stored in the specified window's window object by SetWRefCon.
SetWRefCon	Sets a reference constant in the specified window's window object.
GetWindowStandardState	Gets the window's standard state rectangle.
SetWindowStandardState	Sets the window's standard state rectangle.
GetWindowUserState	Gets the window's user state rectangle.
SetWindowUserState	Sets the window's user state rectangle.

## Events in Windows

As stated in Chapter 2, the Window Manager itself generates two types of events central to window management, namely, activate events and update events.

One of the Window Manager's main tasks is to report the location of the cursor when the application receives a mouse-down event. As was also stated in Chapter 2, the Window Manager function FindWindow may be used to determine whether the cursor is in a window when the mouse-down occurs and, if it is in a window, in exactly which window and which part of that window. FindWindow is thus the function which enables you to distinguish between those mouse-down events that affect the window itself and those that affect the document displayed in the window.

## Creating Your Application's Windows

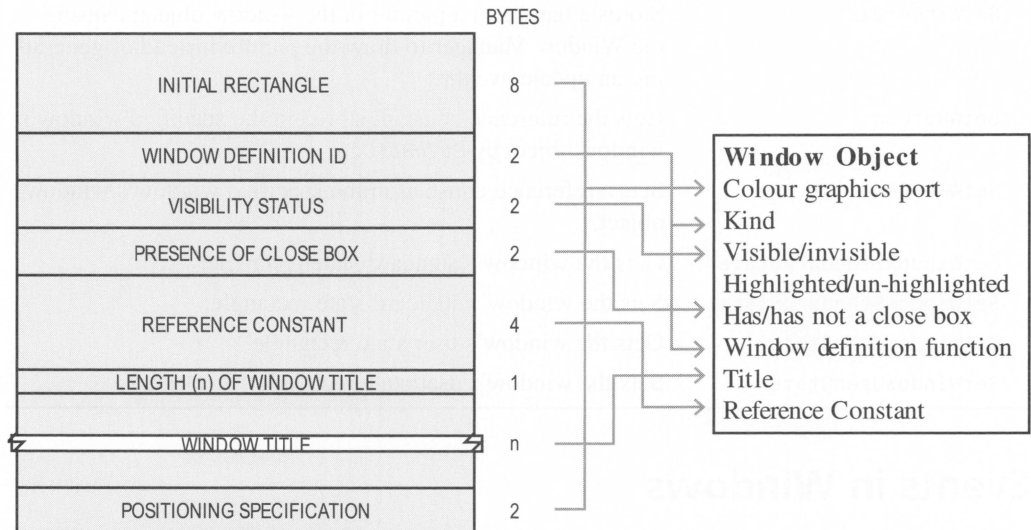
You typically create document and floating windows from resources of type 'WIND', although you can create them programmatically using the function NewCWindow. Additional methods of creating windows, including floating windows, programmatically are described in Chapter 16.

### 'WIND' Resources

When creating resources with Resorcerer, it is advisable that you refer to a diagram and description of the structure of the resource and relate that to the various items in the Resorcerer editing windows. Accordingly, the following describes the structure of the resource associated with the creation of document and floating windows.

## Structure of a Compiled 'WIND' Resource

Fig 10 shows the structure of a compiled 'WIND' resource and how it “feeds” the window object.



**FIG 10 - STRUCTURE OF A COMPILED WINDOW ('WIND') RESOURCE**

The following describes the main fields of the 'WIND' resource:

Field	Description
INITIAL RECTANGLE	A rectangle that defines the initial size and placement, in global coordinates, of the window's content region. This rectangle can be changed before displaying the window, either programmatically or by using an optional positioning specification.
WINDOW DEFINITION ID	The window's definition ID.
VISIBILITY STATUS	Specifies whether the window is to be visible or invisible. Note that this really means whether the Window Manager displays the window; it does not necessarily mean that the window can be seen on the screen. (A visible window might be completely covered by other windows; nevertheless its visibility status is still “visible.”)



<i>Field</i>	<i>Description</i>
PRESENCE OF CLOSE BOX/BUTTON	Specifies whether the window is to have a close box/button.
REFERENCE CONSTANT	A reference constant that your application can use for whatever data it needs to associate with the window. When it builds a new window object, the Window Manager stores in that object whatever value you specify in this field. (You can also store a reference constant in the window object programmatically via a call to SetWRefCon.)
WINDOW TITLE	A string that specifies the window's title.
POSITIONING SPECIFICATION	<p>A positioning specification (optional). If this field contains a positioning specification, it overrides the window position established by the rectangle in the first field.</p> <p>The positioning constants which may be assigned to this field are very useful for specifying the initial position of dialogs, alerts, and windows for new documents. However, the position (and size) of a new window intended to display a previously saved document should be the same as the window position (and size) when the document was last displayed.</p>

### Positioning Specification

The constants for the positioning specification field are as follows:

<i>Constant</i>	<i>Value</i>	<i>Meaning</i>
kWindowNoPosition	0x0000	Use initial rectangle.
kWindowDefaultPosition	0x0000	Use initial rectangle.
kWindowCenterMainScreen	0x280A	Center on main screen.
kWindowAlertPositionMainScreen	0x300A	Place in alert position on main screen.
kWindowStaggerMainScreen	0x380A	Stagger on main screen.
kWindowCenterParentWindow	0xA80A	Center on parent window.
kWindowAlertPositionParentWindow	0xB00A	Place in alert position on parent window.

<i>Constant</i>	<i>Value</i>	<i>Meaning</i>
kWindowStaggerParentWindow	0xB80A	Stagger relative to parent window.
kWindowCenterParentWindowScreen	0x680A	Center on parent window screen.
kWindowAlertPositionParentWindowScreen	0x700A	Alert position on parent window screen.
kWindowStaggerParentWindowScreen	0x780A	Stagger on parent window screen.

## Creating a 'WIND' Resource Using Resorcerer

Fig 11 shows a 'WIND' resource being created with Resorcerer.

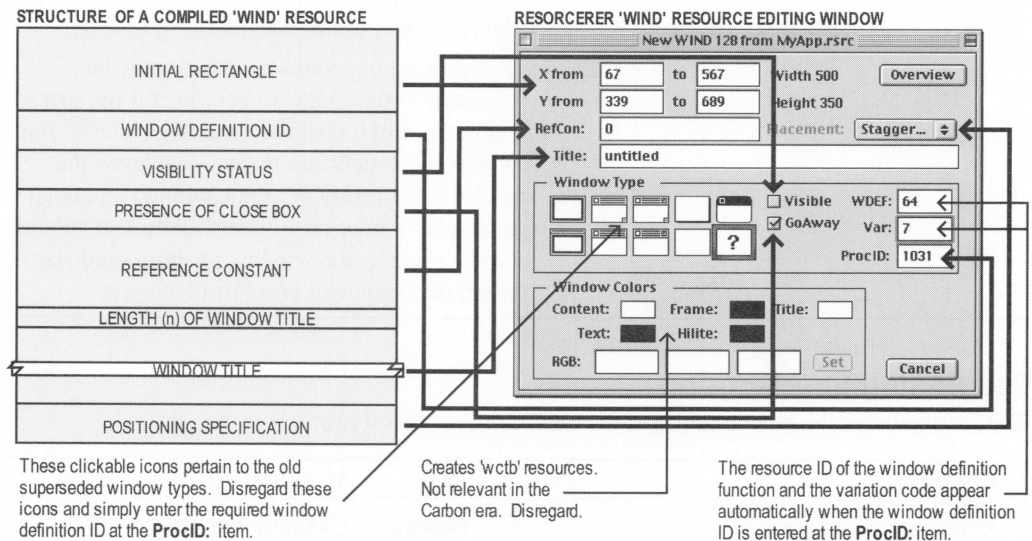


FIG 11 - CREATING A 'WIND' RESOURCE USING RESORCERER

## Creating the Window from the 'WIND' Resource

GetNewCWindow is used to create a window from a 'WIND' resource.

### Adding Scroll Bars

If a window requires scroll bars, you typically create them from 'CNTL' resources at the time that you create the document window, and then display them when you make the window visible (see Chapter 7).

## Window Visibility

If the 'WIND' resource specifies that the new window is visible, `GetNewCWindow` displays the window immediately. If you are creating a document window, however, it is best to create the window in an invisible state and then make it visible when you are ready to display it. The right time to display a window depends on whether the window is associated with a new or a saved document.

- If you are creating a window because the user is creating a new document, you should display the window immediately (by calling `ShowWindow`).
- If you are creating a new window to display a saved document, you should retrieve the document and draw it in the window before calling `ShowWindow`.

## Positioning a New Document Window on the Desktop

The positioning constants previously described allow you to position new windows automatically. When used, those positioning constants concerned with staggering new window placement will ensure that the Window Manager will use any vacated position for the next new window.

## Getting Available Window Positioning Bounds

Carbon introduced the function `GetAvailableWindowPositioningBounds`, which allows your application to determine the available window positioning bounds on a given screen. The function returns the bounds of the screen rectangle less the menu bar and, on Mac OS X, the Dock.

## Positioning a Saved Document Window on the Desktop

For windows created for the purpose of displaying a saved document, you should replicate the size and location of the document's window as it was when the document was last saved.

When the user saves a document, you must therefore also save the **user state** rectangle and the current **zoom state** of the window (that is, whether the window is in the user state or the **standard state**).

## User State, Standard State, and Zoom State

Some explanation of user state and standard state is necessary. The user state is the last size and position the user, through sizing and dragging actions, established for a window. The standard state is the size and position that your application defines as being best for the display of the data contained in the window.

The user and standard states are stored in the window object and may be set and retrieved using the functions `GetWindowStandardState`, `SetWindowStandardState`, `GetWindowUserState`, and `SetWindowUserState` (see the section "Accessor Functions").

In addition, the function `IsWindowInStandardState` allows your application to determine the current zoom state—that is, whether the window is zoomed “out” to the standard state or zoomed “in” to the user state.

## Saving the Window State

Returning to the matter of saving the user state and the current zoom state of the window, for windows with zoom boxes/buttons you typically store this data as a custom resource in the resource fork of the document file.

## Drawing a Window's Contents

Your application is responsible for drawing a window's contents. It typically uses the Control Manager to draw the window's controls and then draws the user data itself.

## Managing Multiple Windows and Associated Data

Your application is likely to have multiple windows open on the desktop at once, each of which will have some form of data, such as text, associated with it. This data, which is external to the window object, is regarded as the “property” of an individual window.

As previously stated, you can store a reference constant in a window object using the function `SetWRefCon`. Typically, your application will use `SetWRefCon` to store a handle to a structure containing the window's external data. This structure, usually referred to as a **document structure**, might hold a handle to the text being edited, handles to the scroll bars, a file reference number and a file system specification for the document's file, plus a flag indicating whether data has changed since the last save, as shown in the following example:

```
typedef struct
{
    TEHandle      editRec;
    ControlHandle vScrollBar;
    ControlHandle hScrollBar;
    short         fileRefNum;
    FSSpec        fileFSSpec;
    boolean       windowTouched;
} docStructure;
typedef docStructure **docStructureHdl;
```

Your application can retrieve the reference constant using the function `GetWRefCon`.

## Handling Events

### Handling Mouse Events

Your application, when it is the active application, receives all mouse-down events in its menu bar and its windows. When it receives a mouse-down event, your application should call `FindWindow` to ascertain which window, and which part of that window, the mouse-down occurred in. (In this context, the menu bar is considered to be a window part). The application should then take the appropriate action based on which window, and which part of that window, the mouse-down occurred in.

### Mouse-Downs in Inactive Windows

When you receive a mouse-down event in an inactive document window or modeless dialog, and if the active window is a document window or a modeless dialog, you should call `SelectWindow`, passing it the window reference. `SelectWindow` re-layers the windows as necessary, removes highlighting from the previously active window, brings the newly activated window to the front, highlights it and generates the activate and update events necessary to tell all affected applications which windows must be redrawn.

Note that, if the active window is a modal or movable modal alert or dialog, no action is required by your application. Modal and movable modal alerts and dialogs are handled by the `ModalDialog` function, which does not pass the event to your application.

### Handling Keyboard Events

Whenever your application is the active application, it receives all key-down events (except, of course, for the system-defined Command-Shift-number key sequences).

When you receive a key-down event, you should first check whether the user is holding down a modifier key and another key at the same time. Your application should respond to key-down events by inserting data into the document, changing the display or taking other appropriate actions. Typically, your application provides feedback for standard keystrokes by drawing the character on the screen.

### Handling Update Events

#### Handling Update Events—Mac OS 8/9

On Mac OS 8/9, the Window Manager maintains an update region for each window. The update region represents the parts of a window's content region that have been affected by changes to the desktop and need redrawing. The Event Manager continually scans the window objects of all the windows on the desktop, looking for non-empty update regions. If it finds an update region that is not empty, it generates an update event for that window.

When your application receives an update event, it should redraw the content area. When your application redraws the content area, the Window Manager clips all screen drawing to the **visible region** of the window's graphics port. The visible region is that part of a graphics port that is not covered by other windows—that is, the part that is actually visible on screen. The Window Manager stores a handle to the visible region in the graphics port object.

Before redrawing the content area, your application should call `BeginUpdate` and, when it has completed the drawing, it should call `EndUpdate`. As shown in Fig 12, `BeginUpdate` temporarily adjusts the visible region to equate to the intersection of the visible region and the update region. Because `QuickDraw` limits its drawing to this temporarily modified visible region, only those parts of the window that actually need updating are drawn. `BeginUpdate` also clears the update region, thus ensuring that the Event Manager does not continue sending an endless stream of update events.

When the drawing is completed, as shown in Fig 12, `EndUpdate` restores the visible region of the graphics port to the full visible region.

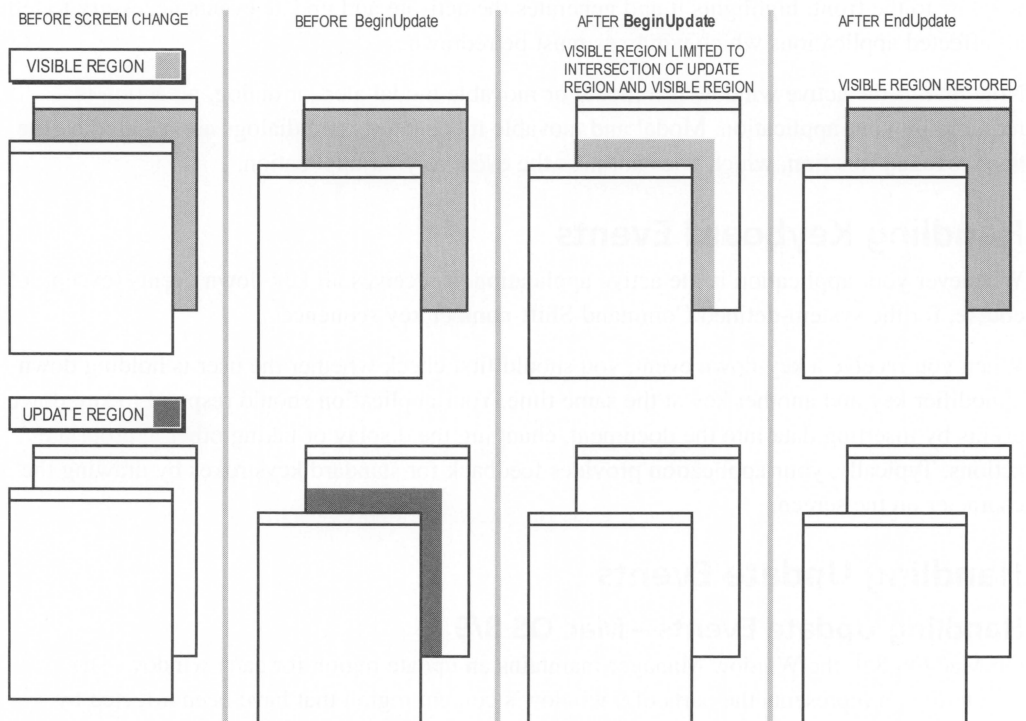


FIG 12 - EFFECTS OF `BeginUpdate` AND `EndUpdate` ON VISIBLE AND UPDATE REGIONS



The reason for these update region/visible region machinations is that the handle to the update region is stored in the window object while the handle to the visible region is stored in the graphics port object. QuickDraw knows the graphics port object intimately, but knows nothing about the window object or its contents. QuickDraw needs something it can work with, hence the above process whereby the visible region is temporarily made the equivalent of the update region while QuickDraw does its drawing.

### Manipulating the Update Region

Your application can force or suppress update events by manipulating the update region. You can call `InValWindowRect` or `InvalWindowRgn` to add a rectangle or region to the update region, thus causing an update event to be generated and, as a consequence, that area to be redrawn. You can also remove a rectangle or region from the update region by calling `ValidWindowRect` or `ValidWindowRgn` so as to decrease the time spent redrawing. For example, an unaffected text area could be removed from the update region of a window that is being resized.

### Handling Update Events—Mac OS X

On Mac OS X, windows are double-buffered, meaning that your application does not draw into the window's graphics port itself but rather into a separate buffer. The Window Manager flushes the buffer to the window's graphics port when your application calls `WaitNextEvent`. On Mac OS X, your application does not require update events to cater for the situation where part, or all, of a window's content region has just been exposed as a result of the user moving an overlaying window.

The receipt of an update event on Mac OS X simply means that your application should draw the required contents of the window. The swapping of visible and update regions required on Mac OS 8/9 is not required, so calls to `BeginUpdate` and `EndUpdate` are irrelevant (and ignored) on Mac OS X.

As is the case on Mac OS 8/9, your application can force the generation of an update event by calling `InValWindowRect` or `InvalWindowRgn`. (Your application can also force the buffer to be flushed to the window's graphics port by calling the QuickDraw function `QDFlushPortBuffer`. This is required, for example, when your application is drawing periodically in a loop that does not call `WaitNextEvent`.)

### Type-Dependent Update Functions

An update function should typically first determine whether the type of window being updated is a document window or some other type of window. If the window is a document window, a document window updating function should be called. If the window is a modeless dialog, an updating function for that modeless dialog should be called.

## Handling Activate Events

Activate events are generated by the Window Manager to inform your application that a window is becoming active or is about to be made inactive. Each activate event specifies the window to be changed and whether the window is to be activated or deactivated.

Your application typically triggers activate events itself by calling `SelectWindow` following a mouse-down event in a nonactive window. `SelectWindow` brings the window in which the mouse-down occurred to the front, adds highlighting to that window, and removes highlighting from the previously active window. `SelectWindow` then generates one activate event to tell your application to perform its part of the deactivation of the previously active window, followed by and another activate event to tell your application to perform its part of the activation of the newly activated window.

When your application receives the event for the window about to be made inactive, it should hide the window's controls and remove any highlighting of selections. When your application receives the event for the newly activated window, it should draw the controls and restore the content area as necessary. This latter might involve, for example, adding the insertion point at its former location or highlighting the previously highlighted selection.

The function for handling activate events should typically first determine whether the window being activated/deactivated is a document window or a modeless dialog. It should then perform the appropriate activation/deactivation actions. The function does not need to check for modal alerts or modal dialogs because the Dialog Manager's `ModalDialog` function automatically handles activate events for those windows.

## Manipulating Windows

### Dragging a Window

When a mouse-down event occurs in the title bar, your application should call `DragWindow`, which tracks the user's actions until the mouse button is released. `DragWindow` moves an image of the window on the screen as the user moves the mouse. When the user releases the mouse, `DragWindow` redraws the window in its new location. The window is then activated (unless the Command key was pressed during the drag).

The area within which the window may be dragged is specified by a `Rect` variable passed in `DragWindow`'s `boundsRect` parameter.

### Carbon Note

In Carbon, assigning `NULL` to the `boundsRect` parameter has the effect of setting the parameter to the bounding rectangle of the desktop region.

## Zooming a Window

The zoom box/button allows the user to alternate between two window sizes and positions known as the user state and the standard state. To amplify the previous description of user state and standard state:

- The user state is the window size and location established by the user. (If the user has not yet moved or resized the window, the user state is the size and location of the window when it was created.)
- The standard state is the size and position that your application specifies as being the optimum for the display of the data contained in the window. In a word-processing program, for example, a window in the standard state might show the full width of a page and as much length as will fit on the screen. If the user changes the page size using the Page Setup dialog, the application might adjust the standard state width to reflect the new page width.
- The user and standard states are stored in the window object. The Window Manager sets the initial standard and user states when it fills in the window object on creation, and it updates the user state whenever the user resizes the window.

Mac OS 8.5 introduced new functions for implementing window zooming. Prior to Mac OS 8.5, when `FindWindow` returned either `inZoomIn` or `inZoomOut`, your application would call `TrackBox` to handle highlighting of the zoom box/button and to determine whether the cursor was inside or outside the zoom box/button when the button was released. If `TrackBox` returned `true`, your application would call `ZoomWindow` to resize the window.

The advantage of the `ZoomWindowIdeal` function introduced with Mac OS 8.5 is that, unlike `ZoomWindow`, it zooms the window in accordance with the following Apple human interface guidelines relating to a window's standard state:

- “A window should move as little as possible when zooming between the user state and standard state, to avoid distracting the user.”
- “A window in its standard state should be positioned so that it is entirely on one screen.”

- “If a window straddles more than one screen in the user state, when it is zoomed to the standard state it should be zoomed to the screen that contains the largest portion of the window’s content region.”
- “If the ideal size for the standard state is larger than the destination screen, the dimensions of the standard state should be that of the destination screen, minus a few pixels of boundary. If the destination screen is the main screen, space should also be left for the menu bar.”
- “When a window is zoomed from the user state to the standard state, the top left corner of the window should remain anchored in place; however, if the standard state of the window cannot fit on the screen with the top left corner anchored, the window should be “nudged” so that the parts of the window in the standard state that would fall offscreen are, instead, just onscreen.”

Other advantages of `ZoomWindowIdeal` are that

- It allows you to specify, in its `ioIdealSize` parameter, the desired height and width of the window’s content region in the standard state.
- On Mac OS X, it takes account of the current height of the Dock when zooming to the standard state and constrains the zoom accordingly.

When `ZoomWindowIdeal` is used, another function introduced with Mac OS 8.5 (`IsWindowInStandardState`) must be used to determine the appropriate part code (`inZoomIn` or `InZoomOut`) to pass in `ZoomWindowIdeal`’s `partCode` parameter.

## Vertical or Horizontal Zoom Boxes—Mac OS 8/9

Your application should ensure that, when a vertical zoom box is clicked, only the vertical size of the associated window changes. Similarly, when a horizontal zoom box is clicked, your application should ensure that only the horizontal size of the associated window changes.

## Resizing a Window

Mac OS 8.5 introduced a new function for implementing window re-sizing. Prior to Mac OS 8.5, when the user pressed the mouse button in the size box, your application would call `GrowWindow`. This function displayed a **grow image**, a dotted outline of the window frame and scroll bar area which expanded and contracted as the user dragged the size box. When the user released the mouse button, `GrowWindow` returned a long integer which described the window’s new height (in the high-order word) and width (in the low-order word). A value of zero indicated that the window size did not change. When the mouse-button was released and `GrowWindow` returned a non-zero value, your application called `SizeWindow` to draw the window in its new size.

The function introduced with Mac OS 8.5 is `ResizeWindow`. `ResizeWindow` moves a grow image around the screen, following the user's cursor movements, and handles all user interaction until the mouse button is released. Unlike the function `GrowWindow`, there is no need to follow this call with a call to `SizeWindow`. Once resizing is complete, `ResizeWindow` draws the window in its new size.

If you pass `NULL` in `ResizeWindow`'s `sizeConstraints` parameter, resizing will be constrained by the default minimum size (64 by 64 pixels) and the default maximum size (the bounding rectangle of the desktop region). However, the option is available to supply custom upper and lower resizing limits in the fields of a `Rect` variable passed in the `sizeConstraints` parameter. The limits represented by each field are as follows:

- `sizeConstraints.top` represents the minimum vertical measurement.
- `sizeConstraints.left` represents the minimum horizontal measurement.
- `sizeConstraints.bottom` represents the maximum vertical measurement.
- `sizeConstraints.right` represents the maximum horizontal measurement.

Note that the values assigned represent window dimensions, *not* screen coordinates.

Following a window resize, your application should adjust its scroll bars and window contents to accommodate the new size.

### Carbon Note

In Carbon, `NULL` may be assigned to `ResizeWindow`'s `newContentRect` parameter if the new dimension of the window's content region is not required.

## Closing a Window

The user closes a window by clicking in the close box/button or by choosing `Close` from the `File` menu.

When the user clicks in the close box/button, `TrackGoAway` should be called to track the mouse until the user releases the mouse button. If `TrackGoAway` returns `true`, meaning that the user did not release the mouse button outside the close box/button, your application should call its function for closing down the window.

The actions taken by your window closing function depend on the type of information the window contains and whether the contents need to be saved. The function should cater for different types of windows, that is, modeless dialogs (which may be merely hidden with `HideWindow` rather than closed completely) and standard document windows. In the latter case, the function

should check whether any changes have been made to the document since it was opened and, if so, provide the user with an opportunity to save the document to a file before closing the window. (This whole process is explained in detail at Chapter 18.)

As for the window itself, `DisposeWindow` removes a window from the screen, removes it from the window list, and discards all of its data storage, including the window object.

## Hiding and Showing a Window

Ordinarily, when the user elects to close a window, you dispose of the window. In some circumstances, however, it may be more appropriate to simply hide the window instead of removing its data structures. It is usually more appropriate, for example, to hide, rather than dispose of, modeless dialogs. That way, when the user next chooses the relevant menu command, the dialog is already available, and in the same location, as when it was last used.

`HideWindow` hides a window. `ShowWindow` will make the window visible and `SelectWindow` will make it the active window.

## Providing Help Balloons (Mac OS 8/9)

### Help Balloons—'hrct' and 'hwin' Resources

The Mac OS 8/9 system software provides help balloons for the title bar, draggable area, close box, zoom box, and collapse box for windows created with the standard WDEFs. Where applicable, you should provide help balloons for the content area of your windows.

How you choose to provide help balloons for the content area depends mainly on whether your windows are **static** or **dynamic**. A static window does not change its title or reposition any of the objects within its content area. A dynamic window can reposition any of its objects within its content area, or its title may change. For example, any window that scrolls past areas of interest to the user is a dynamic window because the object with associated help balloons can change location as the user scrolls. The following addresses the case of static windows only.

Help balloons for static document and floating windows are defined in 'hrct' and 'hwin' resources.

### Creating 'hrct' and 'hwin' Resources Using Resorcerer

The 'hrct' (rectangle help) resource is used to define **hot rectangles** for displaying help balloons in a static window and to specify the help messages for those balloons. All 'hrct' resources must have resource IDs equal to or greater than 128. Fig 13 shows an 'hrct' resource being created using Resorcerer.



## STRUCTURE OF A COMPILED hrct' RESOURCE

HELP MANAGER VERSION
OPTIONS
BALLOON DEFINITION FUNCTION
VARIATION CODE
HOT RECTANGLE COMPONENT COUNT
FIRST HOT RECTANGLE COMPONENT
LAST HOT RECTANGLE COMPONENT

The structure of the hot rectangle component depends on the item chosen in the **Message Type** pop-up menu in the Resorcerer editing window below, which sets the TYPE OF DATA field. The pop-up menu items specify the format of the help balloon messages. The available formats are as follows:

### Use these strings

Use 'PICT' resources

Use 'STR#' resources

Used styled text resources

Use 'STR' resources

Skip missing item

Use the string specified within this component of this 'href' resource. (Specified in this example.)

Use the picture stored in the specified 'PICT' resource.

Use the specified text string stored in the specified 'STR#' resource.

Use the styled text stored in the specified 'TEXT' and 'styl' resources.

Use the text string stored in the specified 'STR' resource.

No help message. Skip this item.

### STRUCTURE OF HOT RECTANGLE COMPONENT

SIZE
TYPE OF DATA
TIPS COORDINATES
HOT RECTANGLE
TEXT STRING
ALIGNMENT BYTES

Header component

Help Manager version

A number of options. 0, below, is irrelevant. 1 is not relevant for static windows. 2 and 3 relate to the three different ways that the Help Manager draws and removes balloons. 4 is used in 'hwin' resources only.

Resource ID of the window definition function (WDEF) used for drawing help balloons. The standard WDEF's resource ID is 126. This can be specified by 0 in Resorcerer.

Variation code for WDEF. Governs the location of the balloon's tip.

The number of hot rectangle components defined in the rest of this resource.

Pascal string in  
this component

Coordinates of balloon's tip

Coordinates of hot rectangle

Help message

## RESORCERER 'hrct' RESOURCE EDITING WINDOW

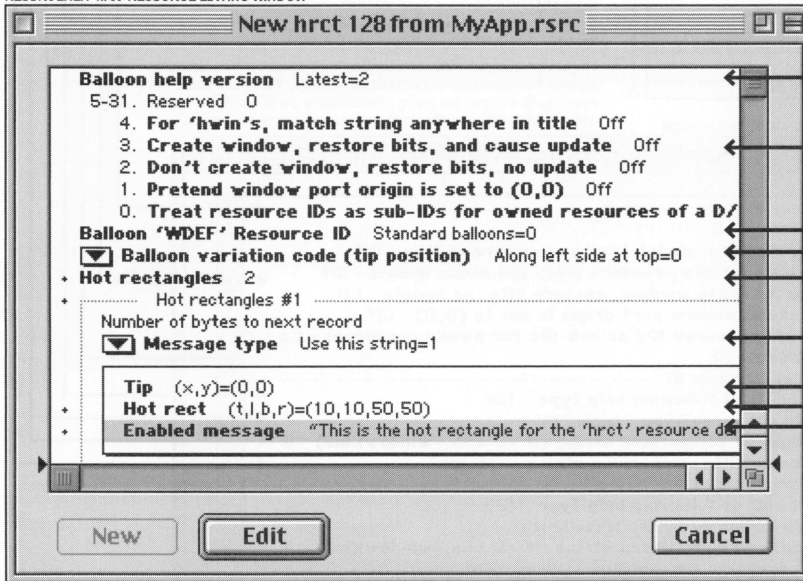


FIG 13 - CREATING AN 'hrct' RESOURCE USING RESORCERER

The 'hwin' (window help) resource is used to associate the help balloons defined in an 'hrc't' resource with a particular window. All 'hrc't' resources must have resource IDs equal to or greater than 128. Fig 14 shows an 'hwin' resource being created using Resorcerer.

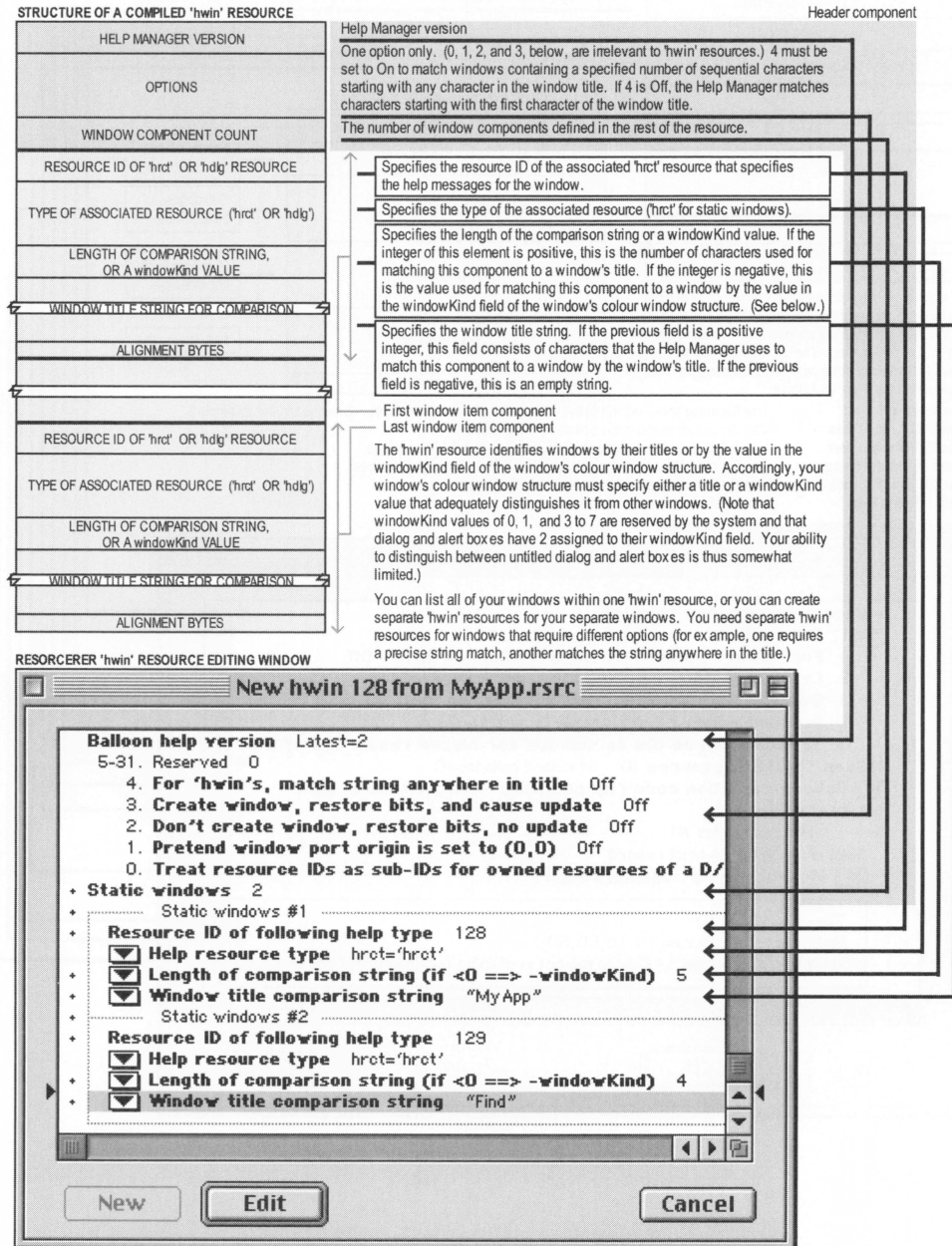


FIG 14 - CREATING AN 'hwin' RESOURCE USING RESORCERER

# Main Window Manager Constants, Data Types, and Functions

## Constants

### Window Types

kWindowDocumentProc	= 1024	Document windows
kWindowGrowDocumentProc	= 1025	
kWindowVertZoomDocumentProc	= 1026	
kWindowVertZoomGrowDocumentProc	= 1027	
kWindowHorizZoomDocumentProc	= 1028	
kWindowHorizZoomGrowDocumentProc	= 1029	
kWindowFullZoomDocumentProc	= 1030	
kWindowFullZoomGrowDocumentProc	= 1031	
kWindowPlainDialogProc	= 1040	Dialogs and Alerts
kWindowShadowDialogProc	= 1041	
kWindowModalDialogProc	= 1042	
kWindowMovableModalDialogProc	= 1043	
kWindowAlertProc	= 1044	
kWindowMovableAlertProc	= 1045	
kWindowMovableModalGrowProc	= 1046	
kWindowFloatProc	= 1057	Floating windows
kWindowFloatGrowProc	= 1059	
kWindowFloatVertZoomProc	= 1061	
kWindowFloatVertZoomGrowProc	= 1063	
kWindowFloatHorizZoomProc	= 1065	
kWindowFloatHorizZoomGrowProc	= 1067	
kWindowFloatFullZoomProc	= 1069	
kWindowFloatFullZoomGrowProc	= 1071	
kWindowFloatSideProc	= 1073	
kWindowFloatSideGrowProc	= 1075	
kWindowFloatSideVertZoomProc	= 1077	
kWindowFloatSideVertZoomGrowProc	= 1079	
kWindowFloatSideHorizZoomProc	= 1081	
kWindowFloatSideHorizZoomGrowProc	= 1083	
kWindowFloatSideFullZoomProc	= 1085	
kWindowFloatSideFullZoomGrowProc	= 1087	

### Window Kind

kDialogWindowKind	= 2
kApplicationWindowKind	= 8

### Window Part Codes Returned by FindWindow

inDesk	= 0
inNoWindow	= 0
inMenuBar	= 1
inSysWindow	= 2
inContent	= 3
inDrag	= 4
inGrow	= 5
inGoAway	= 6

```

inZoomIn           = 7
inZoomOut          = 8
inCollapseBox      = 11
inProxyIcon        = 12

```

### Regions Codes Passed to GetWindowRegion

```

kWindowTitleBarRgn      = 0
kWindowTitleTextRgn     = 1
kWindowCloseBoxRgn     = 2
kWindowZoomBoxRgn      = 3
kWindowDragRgn         = 5
kWindowGrowRgn         = 6
kWindowCollapseBoxRgn   = 7
kWindowStructureRgn     = 32
kWindowContentRgn       = 33
kWindowUpdateRgn       = 34
kWindowGlobalPortRgn    = 40

```

### Options For ScrollWindowRect and ScrollWindowRegion

```

kScrollWindowNoOptions      = 0
kScrollWindowInvalidate     = (1L << 0)  Add exposed area to window's update region.
KScrollWindowEraseToPortBackground = (1L << 1)  Erase exposed area using background color/
                                                pattern of the window's grafport.

```

## Data Types

```

typedef struct OpaqueWindowPtr* WindowPtr;
typedef WindowPtr WindowRef;
typedef SInt16 WindowPartCode;
typedef UInt16 WindowRegionCode;
typedef UInt32 OptionBits;
typedef OptionBits ScrollWindowOptions;

```

## Functions

### Creating Windows

```

WindowRef GetNewCWindow(short windowID,void *wStorage,WindowRef behind);
WindowRef NewCWindow(void *wStorage,const Rect *boundsRect,ConstStr255Param title,Boolean
    visible,short procID,WindowRef behind,Boolean goAwayFlag,long refCon);

```

### Naming Windows

```

void GetWTitle(WindowRef theWindow,Str255 title);
void SetWTitle(WindowRef theWindow,ConstStr255Param title);
OSStatus CopyWindowTitleAsCFString(WindowRef inWindow,CFStringRef *outString);
OSStatus SetWindowTitleWithCFString(WindowRef inWindow,CFStringRef inString);

```

### Displaying Windows

```

Boolean IsWindowVisible(WindowRef window);
void ShowWindow(WindowRef theWindow);
void HideWindow(WindowRef theWindow);
void ShowHide(WindowRef theWindow,Boolean showFlag);

```

```

Boolean    IsWindowHilited(WindowRef window);
void       HiliteWindow(WindowRef theWindow, Boolean fHilite);
void       SelectWindow(WindowRef theWindow);
void       BringToFront(WindowRef theWindow);
void       SendBehind(WindowRef theWindow, WindowRef behindWindow);
void       DrawGrowIcon(WindowRef theWindow);

```

## Moving Windows

```

void       MoveWindow(WindowRef theWindow, short hGlobal, short vGlobal, Boolean front);
void       DragWindow(WindowRef theWindow, Point startPt, const Rect *boundsRect);

```

## Resizing Windows

```

long       GrowWindow(WindowRef theWindow, Point startPt, const Rect *bBox);
void       SizeWindow(WindowRef theWindow, short w, short h, Boolean fUpdate);
Boolean    ResizeWindow(WindowRef window, Point startPoint, const Rect *sizeConstraints,
                        Rect *newContentRect);

```

## Zooming Windows

```

Boolean    TrackBox(WindowRef theWindow, Point thePt, short partCode);
void       ZoomWindow(WindowRef theWindow, short partCode, Boolean front);
OSStatus   ZoomWindowIdeal(WindowRef window, Sint16 partCode, Point *ioIdealSize);
Boolean    IsWindowInStandardState(WindowRef window, Point *idealSize, Rect *idealStandardState);
OSStatus   SetWindowIdealUserState(WindowRef window, Rect *userState);
OSStatus   GetWindowIdealUserState(WindowRef window, Rect *userState);

```

## Deallocating Windows

```

Boolean    TrackGoAway(WindowRef theWindow, Point thePt);
void       DisposeWindow(WindowRef theWindow);

```

## Collapsing Windows

```

Boolean    IsWindowCollapsible(WindowRef inWindow);
Boolean    IsWindowCollapsed(WindowRef inWindow);
OSStatus   CollapseWindow(WindowRef inWindow, Boolean inCollapseIt);
OSStatus   CollapseAllWindows(Boolean inCollapseEm);

```

## Window Kind

```

short      GetWindowKind(WindowRef window);
void       SetWindowKind(WindowRef window, short kind);

```

## Window Regions

```

OSStatus   GetWindowRegion(WindowRef inWindow, WindowRegionCode inRegionCode,
                        RgnHandle ioWinRgn)

```

## Window User State and Standard State

```

Rect*      GetWindowStandardState(WindowRef window, Rect *rect);
Rect*      GetWindowUserState(WindowRef window, Rect *rect);
void       SetWindowStandardState(WindowRef window, const Rect *rect);
void       SetWindowUserState(WindowRef window, const Rect *rect);
Boolean    IsWindowInStandardState(WindowRef window, Point *idealSize, Rect idealStandardState);

```

## Getting Available Window Positioning Bounds

```
OSStatus GetAvailableWindowPositioningBounds(GDHandle inDevice, Rect *availableRect);
```

## Maintaining the Update Region

```
void BeginUpdate(WindowRef theWindow);
void EndUpdate(WindowRef theWindow);
Boolean IsWindowUpdatePending(WindowRef window);
OSStatus InvalWindowRgn(WindowRef window, RgnHandle region);
OSStatus InvalWindowRect(WindowRef window, const Rect *bounds);
OSStatus ValidWindowRgn(WindowRef window, RgnHandle region);
OSStatus ValidWindowRect(WindowRef window, const Rect *bounds);
```

## Retrieving Mouse Information

```
short FindWindow(Point thePoint, WindowRef *theWindow);
WindowRef FrontWindow(void);
```

## Window Reference Constant, Variant, and Picture

```
long GetWRefCon(WindowRef theWindow);
void SetWRefCon(WindowRef theWindow, long data);
short GetWVariant(WindowRef theWindow);
void SetWindowPic(WindowRef theWindow, PicHandle pic);
PicHandle GetWindowPic(WindowRef theWindow);
```

## Window List

```
WindowRef GetWindowList(void);
WindowRef GetNextWindow(WindowRef window);
```

## Window's Graphics Port

```
CGrafPtr GetWindowPort(WindowRef window);
void SetPortWindowPort(WindowRef window);
WindowRef GetWindowFromPort(CGrafPtr port);
Rect* GetWindowPortBounds(WindowRef window, Rect *bounds);
```

## Gray Region

```
RgnHandle GetGrayRgn(void);
```

## Scrolling Pixels in the Window Content Region

```
OSStatus ScrollWindowRect(WindowRef window, const Rect *scrollRect, Sint16 hPixels,
    Sint16 vPixels, ScrollWindowOptions options, RgnHandle outExposedRgn);
OSStatus ScrollWindowRegion(WindowRef window, RgnHandle scrollRgn,
    Sint16 hPixels, vPixels, ScrollWindowOptions options, RgnHandle outExposedRgn);
```

# Demonstration Program Windows1 Listing

```
// *****
// Windows1.c CLASSIC EVENT MODEL
// *****
//
// This program:
//
```



```

// · Allows the user to open any number of kWindowFullZoomGrowDocumentProc windows, up to the
// maximum specified by the constant assigned to the symbolic name kMaxWindows, using the
// File menu Open Command or its keyboard equivalent.
//
// · Allows the user to close opened windows using the close box/button, the File menu Close
// command or the Close command's keyboard equivalent.
//
// · Adds menu items representing each window to a Windows menu as each window is opened.
// (A keyboard equivalent is included in each menu item for windows 1 to 9.)
//
// · Deletes menu items from the Windows menu as each window is closed.
//
// · Fills each window with a plain color pattern as a means of proving, for demonstration
// purposes, the window update process.
//
// · Facilitates activation of a window by mouse selection.
//
// · Facilitates activation of a window by Windows menu selection.
//
// · Correctly performs all dragging, zooming and sizing operations.
//
// · On Mac OS 8/9, demonstrates the provision of balloon help for static windows.
//
// The program utilises the following resources:
//
// · A 'plst' resource.
//
// · An 'MBAR' resource, and 'MENU' resources for Apple/Application, File, Edit and Windows
// menus, (preload non-purgeable).
//
// · A 'WIND' resource (purgeable) (initially not visible).
//
// · A 'STR#' resource containing error strings and the window title (purgeable).
//
// · An 'hrcr' resource and an 'hwin' resource for balloon help (both purgeable).
//
// · Ten 'ppat' (pixel pattern) resources (purgeable), which are used to draw a plain color
// pattern in the windows.
//
// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
// doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenubar          128
#define mAppleApplication 128
#define iAbout            1
#define mFile             129

```

```

#define iNew          1
#define iClose        4
#define iQuit         12
#define mWindows      131
#define rNewWindow    128
#define rStringList   128
#define sUntitled     1
#define eMaxWindows   2
#define eFailWindow   4
#define eFailMenus    5
#define eFailMemory   6
#define rPixelPattern 128
#define kMaxWindows   10
#define kScrollBarWidth 15
#define MAX_UINT32     0xFFFFFFFF
#define MIN(a,b)       ((a) < (b) ? (a) : (b))
#define topLeft(r)      (((Point *) &(r))[0])

// ..... global variables

Boolean  gRunningOnX = false;
Boolean  gDone;
SInt32   gUntitledWindowNumber = 0;
SInt32   gCurrentNumberOfWindows = 0;
WindowRef gWindowRefArray[kMaxWindows + 2];

// ..... function prototypes

void      main                (void);
void      doPreliminaries    (void);
OSErr     quitAppEventHandler (AppleEvent *,AppleEvent *,SInt32);
void      eventLoop          (void);
void      doEvents            (EventRecord *);
void      doMouseDown         (EventRecord *);
void      doUpdate            (EventRecord *);
void      doUpdateWindow      (EventRecord *);
void      doActivate          (EventRecord *);
void      doActivateWindow    (WindowRef,Boolean);
void      doOSEvent           (EventRecord *);
void      doMenuChoice        (SInt32);
void      doFileMenu          (MenuItemIndex);
void      doWindowsMenu       (MenuItemIndex);
void      doNewWindow          (void);
void      doCloseWindow       (void);
void      doInvalidateScrollBarArea (WindowRef);
void      doConcatPStrings    (Str255,Str255);
void      doErrorAlert        (SInt16);
Boolean   eventFilter         (DialogPtr,EventRecord *,SInt16 *);

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;
    MenuRef        menuRef;
    SInt16         a;

```

```

// ..... do preliminaries

doPreliminaries();

// ..... set up menu bar and menus

menubarHdl = GetNewMBar(rMenubar);
if(menubarHdl == NULL)
    doErrorAlert(eFailMenus);
SetMenuBar(menubarHdl);
DrawMenuBar();

Gestalt(gestaltMenuMgrAttr,&response);
if(response & gestaltMenuMgrAquaLayoutMask)
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
    {
        DeleteMenuItem(menuRef,iQuit);
        DeleteMenuItem(menuRef,iQuit - 1);
    }

    gRunningOnX = true;
}

// ..... initialize window reference array

for(a=0;a<kMaxWindows+2;a++)
    gWindowRefArray[a] = NULL;

// ..... enter eventLoop

eventLoop();
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    OSErr osError;

    MoreMasterPointers(224);
    InitCursor();
    FlushEvents(everyEvent,0);

    osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
        NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
        0L,false);

    if(osError != noErr)
        ExitToShell();
}

```

```
// ***** doQuitAppEvent

OSErr quitAppEventHandler(AppleEvent *appEvent, AppleEvent *reply, SInt32 handlerRefcon)
{
    OSErr    osError;
    DescType returnedType;
    Size      actualSize;

    osError = AEGetAddressPtr(appEvent, keyMissedKeywordAttr, typeWildCard, &returnedType, NULL, 0,
                              &actualSize);

    if(osError == errAEDescNotFound)
    {
        gDone = true;
        osError = noErr;
    }
    else if(osError == noErr)
        osError = errAEParamMissed;

    return osError;
}

// ***** eventLoop

void eventLoop(void)
{
    EventRecord eventStructure;

    gDone = false;

    while(!gDone)
    {
        if(WaitNextEvent(everyEvent, &eventStructure, MAX_UINT32, NULL))
            doEvents(&eventStructure);
    }
}

// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEProcessAppleEvent(eventStrucPtr);
            break;

        case mouseDown:
            doMouseDown(eventStrucPtr);
            break;

        case keyDown:
            if((eventStrucPtr->modifiers & cmdKey) != 0)
                doMenuChoice(MenuEvent(eventStrucPtr));
            break;
    }
}
```

```

    case updateEvt:
        doUpdate(eventStrucPtr);
        break;

    case activateEvt:
        doActivate(eventStrucPtr);
        break;

    case osEvt:
        doOSEvent(eventStrucPtr);
        break;
}
}

// ***** doMouseDown

void doMouseDown(EventRecord *eventStrucPtr)
{
    WindowRef      windowRef;
    WindowPartCode partCode, zoomPart;
    BitMap          screenBits;
    Rect            constraintRect, mainScreenRect;
    Point           standardStateHeightAndWidth;

    partCode = FindWindow(eventStrucPtr->where,&windowRef);

    switch(partCode)
    {
        case inMenuBar:
            doMenuChoice(MenuSelect(eventStrucPtr->where));
            break;

        case inContent:
            if(windowRef != FrontWindow())
                SelectWindow(windowRef);
            break;

        case inDrag:
            DragWindow(windowRef,eventStrucPtr->where,NULL);
            break;

        case inGoAway:
            if(TrackGoAway(windowRef,eventStrucPtr->where) == true)
                doCloseWindow();
            break;

        case inGrow:
            constraintRect.top    = 75;
            constraintRect.left   = 205;
            constraintRect.bottom = constraintRect.right = 32767;
            doInvalidateScrollBarArea(windowRef);
            ResizeWindow(windowRef,eventStrucPtr->where,&constraintRect,NULL);
            doInvalidateScrollBarArea(windowRef);
            break;
    }
}

```

```

    case inZoomIn:
    case inZoomOut:
        mainScreenRect = GetQDGlobalsScreenBits(&screenBits)->bounds;
        standardStateHeightAndWidth.v = mainScreenRect.bottom;
        standardStateHeightAndWidth.h = 460;

        if(IsWindowInStandardState(windowRef,&standardStateHeightAndWidth,NULL))
            zoomPart = inZoomIn;
        else
            zoomPart = inZoomOut;

        if(TrackBox(windowRef,eventStrucPtr->where,partCode))
            ZoomWindowIdeal(windowRef, zoomPart, &standardStateHeightAndWidth);
        break;
    }
}

// ***** doUpdate

void doUpdate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;

    windowRef = (WindowRef) eventStrucPtr->message;

    BeginUpdate(windowRef);

    SetPortWindowPort(windowRef);
    doUpdateWindow(eventStrucPtr);

    EndUpdate(windowRef);
}

// ***** doUpdateWindow

void doUpdateWindow(EventRecord *eventStrucPtr)
{
    WindowRef    windowRef;
    RgnHandle     visibleRegionHdl;
    Rect          theRect;
    SInt32        windowRefCon;
    PixPatHandle  pixpatHdl;
    RGBColor      whiteColor = { 0xFFFF,0xFFFF,0xFFFF };
    SInt16        a;

    windowRef = (WindowRef) eventStrucPtr->message;

    visibleRegionHdl = NewRgn();
    GetPortVisibleRegion(GetWindowPort(windowRef),visibleRegionHdl);
    EraseRgn(visibleRegionHdl);
    DisposeRgn(visibleRegionHdl);

    GetWindowPortBounds(windowRef,&theRect);
    theRect.right -= kScrollBarWidth;
    theRect.bottom -= kScrollBarWidth;

```



```

windowRefCon = GetWRefCon(windowRef);
pixpatHdl = GetPixPat(rPixelPattern + windowRefCon);
FillCRect(&theRect,pixpatHdl);
DisposePixPat(pixpatHdl);

DrawGrowIcon(windowRef);

RGBForeColor(&whiteColor);
TextSize(10);

if(!gRunningOnX)
{
    for(a=0;a<2;a++)
    {
        SetRect(&theRect,a*90+10,10,a*90+90,33);
        FrameRect(&theRect);
        MoveTo(a*90+18,25);

        DrawString("\pHot Rectangle");
    }
}

// ***** doActivate

void doActivate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    Boolean becomingActive;

    windowRef = (WindowRef) eventStrucPtr->message;

    becomingActive = ((eventStrucPtr->modifiers & activeFlag) == activeFlag);

    doActivateWindow(windowRef,becomingActive);
}

// ***** doActivateWindow

void doActivateWindow(WindowRef windowRef,Boolean becomingActive)
{
    MenuRef windowsMenu;
    SInt16 menuItem, a = 1;

    windowsMenu = GetMenuRef(mWindows);

    while(gWindowRefArray[a] != windowRef)
        a++;
    menuItem = a;

    if(becomingActive)
        CheckMenuItem(windowsMenu,menuItem,true);
    else
        CheckMenuItem(windowsMenu,menuItem,false);
}

```

```

    DrawGrowIcon(windowRef);
}

// ***** doOSEvent

void doOSEvent(EventRecord *eventStrucPtr)
{
    switch((eventStrucPtr->message >> 24) & 0x000000FF)
    {
        case suspendResumeMessage:
            if((eventStrucPtr->message & resumeFlag) == 1)
                SetThemeCursor(kThemeArrowCursor);
            break;
    }
}

// ***** doMenuChoice

void doMenuChoice(SInt32 menuChoice)
{
    MenuID      menuID;
    MenuItemIndex menuItem;

    menuID = HiWord(menuChoice);
    menuItem = LoWord(menuChoice);

    if(menuID == 0)
        return;

    switch(menuID)
    {
        case mAppleApplication:
            if(menuItem == iAbout)
                SysBeep(10);
            break;

        case mFile:
            doFileMenu(menuItem);
            break;

        case mWindows:
            doWindowsMenu(menuItem);
            break;
    }

    HiliteMenu(0);
}

// ***** doFileMenu

void doFileMenu(MenuItemIndex menuItem)
{
    switch(menuItem)

```

```

{
    case iNew:
        doNewWindow();
        break;

    case iClose:
        doCloseWindow();
        break;

    case iQuit:
        gDone = true;
        break;
}
}

// ***** doWindowsMenu

void doWindowsMenu(MenuItemIndex menuItem)
{
    WindowRef windowRef;

    windowRef = gWindowRefArray[menuItem];
    SelectWindow(windowRef);
}

// ***** doNewWindow

void doNewWindow(void)
{
    WindowRef windowRef;
    Str255    untitledString;
    Str255    numberAsString = "\p1";
    Rect      availableBoundsRect, portRect;
    SInt16     windowHeight;
    MenuRef    windowsMenu;

    if(gCurrentNumberOfWindows == kMaxWindows)
    {
        doErrorAlert(eMaxWindows);
        return;
    }

    if(!(windowRef = GetNewCWindow(rNewWindow, NULL, (WindowRef) -1)))
        doErrorAlert(eFailWindow);

    GetIndString(untitledString, rStringList, sUntitled);
    gUntitledWindowNumber += 1;
    if(gUntitledWindowNumber > 1)
    {
        NumToString(gUntitledWindowNumber, numberAsString);
        doConcatPStrings(untitledString, numberAsString);
    }

    SetWTitle(windowRef, untitledString);

```

```

GetAvailableWindowPositioningBounds(GetMainDevice(),&availableBoundsRect);
GetWindowPortBounds(windowRef,&portRect);
SetPortWindowPort(windowRef);
LocalToGlobal(&topLeft(portRect));
windowHeight = (availableBoundsRect.bottom - portRect.top) - 3;
if(!gRunningOnX)
    windowHeight -= 27;
SizeWindow(windowRef,460,windowHeight,false);

ShowWindow(windowRef);

if(gUntitledWindowNumber < 10)
{
    doConcatPStrings(untitledString,"p/");
    doConcatPStrings(untitledString,numberAsString);
}
windowsMenu = GetMenuRef(mWindows);
InsertMenuItem(windowsMenu,untitledString,CountMenuItems(windowsMenu));

SetWRefCon(windowRef,gCurrentNumberOfWindows);

gCurrentNumberOfWindows ++;
gWindowRefArray[gCurrentNumberOfWindows] = windowRef;

if(gCurrentNumberOfWindows == 1)
{
    EnableMenuItem(GetMenuRef(mFile),iClose);
    EnableMenuItem(GetMenuRef(mWindows),0);
    DrawMenuBar();
}
}

// ***** doCloseWindow

void doCloseWindow(void)
{
    WindowRef windowRef;
    MenuRef windowsMenu;
    SInt16 a = 1;

    windowRef = FrontWindow();
    DisposeWindow(windowRef);
    gCurrentNumberOfWindows --;

    windowsMenu = GetMenuRef(mWindows);
    while(gWindowRefArray[a] != windowRef)
        a++;
    gWindowRefArray[a] = NULL;
    DeleteMenuItem(windowsMenu,a);

    for(a=1;a<kMaxWindows+1;a++)
    {
        if(gWindowRefArray[a] == NULL)

```

```

    {
        gWindowRefArray[a] = gWindowRefArray[a+1];
        gWindowRefArray[a+1] = NULL;
    }
}

if(gCurrentNumberOfWindows == 0)
{
    DisableMenuItem(GetMenuRef(mFile),iClose);
    DisableMenuItem(GetMenuRef(mWindows),0);
    DrawMenuBar();
}
}

// ***** doInvalidateScrollBarArea

void doInvalidateScrollBarArea(WindowRef windowRef)
{
    Rect tempRect;

    SetPortWindowPort(windowRef);

    GetWindowPortBounds(windowRef,&tempRect);
    tempRect.left = tempRect.right - kScrollBarWidth;
    InvalWindowRect(windowRef,&tempRect);

    GetWindowPortBounds(windowRef,&tempRect);
    tempRect.top = tempRect.bottom - kScrollBarWidth;
    InvalWindowRect(windowRef,&tempRect);
}

// ***** doConcatPStrings

void doConcatPStrings(Str255 targetString,Str255 appendString)
{
    SInt16 appendLength;

    appendLength = MIN(appendString[0],255 - targetString[0]);

    if(appendLength > 0)
    {
        BlockMoveData(appendString+1,targetString+targetString[0]+1,(SInt32) appendLength);
        targetString[0] += appendLength;
    }
}

// ***** doErrorAlert

void doErrorAlert(SInt16 errorType)
{
    AlertStdAlertParamRec paramRec;
    ModalFilterUPP          eventFilterUPP;
    Str255                  labelText;
    Str255                  narrativeText;
    SInt16                  itemHit;

```

```

eventFilterUPP = NewModalFilterUPP((ModalFilterProcPtr) eventFilter);

paramRec.movable      = true;
paramRec.helpButton   = false;
paramRec.filterProc    = eventFilterUPP;
paramRec.defaultText   = (StringPtr) kAlertDefaultOKText;
paramRec.cancelText    = NULL;
paramRec.otherText     = NULL;
paramRec.defaultButton = kAlertStdAlertOKButton;
paramRec.cancelButton  = 0;
paramRec.position      = kWindowAlertPositionMainScreen;

GetIndString(labelText,rStringList,errorType);

if(errorType == eMaxWindows)
{
    GetIndString(narrativeText,rStringList,errorType + 1);
    StandardAlert(kAlertCautionAlert,labelText,narrativeText,&paramRec,&itemHit);
    DisposeModalFilterUPP(eventFilterUPP);
}
else
{
    StandardAlert(kAlertStopAlert,labelText,0,&paramRec,&itemHit);
    ExitToShell();
}
}

// ***** eventFilter

Boolean eventFilter(DialogPtr dialogPtr,EventRecord *eventStrucPtr,SInt16 *itemHit)
{
    Boolean handledEvent = false;

    if((eventStrucPtr->what == updateEvt) &&
        ((WindowRef) eventStrucPtr->message != GetDialogWindow(dialogPtr)))
    {
        doUpdate(eventStrucPtr);
    }

    return handledEvent;
}

// *****

```

## Demonstration Program Windows1 Comments

When this program is run, the user should

- Open and close windows using both the Open and Close commands from the File menu and their keyboard equivalents, noting that whenever a window is opened or closed, a menu item representing that window is added to or deleted from the Windows menu.



- Note that keyboard equivalents are added to the menu items in the Windows menu for the first nine windows opened.
- Activate individual windows by both clicking the content region and pressing the keyboard equivalent for the window.
- Send the application to the background and bring it to the foreground, noting window activation/deactivation.
- Zoom, close, and resize windows using the zoom box/button, close box/button and size box/resize control, noting window updating and activation.
- On Mac OS X, note that when a window is zoomed to the standard state, the zoom is constrained by the current height of the Dock.
- On Mac OS 8/9, choose Show Balloons from the Help menu and move the cursor over the hot rectangles in the frontmost window.

If an attempt is made to open more than 10 windows, a movable modal alert appears.

## defines

The first nine `#defines` establish constants representing menu IDs and resources, and window and menu bar resources. The next six establish constants representing the resource ID of a 'STR#' resource and the various strings in that resource. `rPixelFormat` represents the resource ID of the first of ten 'ppat' (pixel pattern) resources. `kMaxWindows` controls the maximum number of windows allowed to be open at one time.

`MAX_UINT32` is defined as the maximum possible `UInt32` value. (This will be assigned to `WaitNextEvent`'s sleep parameter.) The two fairly common macros which follow are required by, respectively, the string concatenation function `doConcatPStrings` and the window creation function `doNewWindow`.

## Global Variables

The global variable `gRunningOnX` will be set to true if the program is running on Mac OS X. `gDone`, when set to true, causes the main event loop to be exited and the program to terminate.

`gUntitledWindowNumber` keeps track of the window numbers to be inserted into the window's title bar. This number is incremented each time a new window is opened.

`gCurrentNumberOfWindows` keeps track of how many windows are open at any one time.

In this program, `CreateStandardWindowMenu` is not used to create the Window menu. The Window menu is created in the same way as the other menus, and managed by the program. `gWindowRefArray[]` is central to the matter of maintaining an association between item numbers in the Window menu and the windows to which they refer, regardless of how many windows are opened and closed, and in what sequence. When, for example, a Window menu item is chosen, the program must be able to locate the window object for the window represented by that menu item number so as to activate the correct window.

The strategy adopted by this program is to assign the references for each opened window to the elements of `gWindowRefArray[]`, starting with `gWindowRefArray[1]` and leaving `gWindowRefArray[0]` unused. If, for example, six windows are opened in sequence, `gWindowRefArray[1]` to `gWindowRefArray[6]` are assigned the references to the window objects for each of those six windows. (At the same time, menu items representing each of those windows are progressively added to the Window menu.)

If, say, the third window opened is then closed, `gWindowRefArray[3]` is set to `NULL` and the window object references in `gWindowRefArray[4]` to `gWindowRefArray[6]` are moved down in the array to occupy `gWindowRefArray[3]` to `gWindowRefArray[5]`. Since the Window menu item for the third window is deleted from the menu when the window is closed, there remains five windows and their associated menu items, the “compaction” of the array having maintained a direct relationship between the number of the array element to which each window reference is assigned and the number of the menu item for that window.

### **main**

The first action is to call `doPreliminaries`, which performs certain preliminary actions common to most applications.

The next block sets up the menus. Note that error handling involving the invocation of alerts is introduced in this program. If an error occurs, the function `doErrorAlert` is called to display either a stop or caution movable modal alert advising of the nature of the error.

In the final three lines, `gWindowRefArray[]` is initialized and the main event loop is entered.

### **doPreliminaries**

Note that `MoreMasterPointers` is called with 224 passed in the `inCount` parameter to provide sufficient master pointers for this program.

### **eventLoop**

`eventLoop` will exit when `gDone` is set to true, which occurs when the user selects Quit from the File menu. (As an aside, note that the `sleep` parameter in the `WaitNextEvent` call is set to `MAX_UINT32`, which is defined as the maximum possible `UInt32` value.)

### **doEvents**

`doEvents` switches according to the event type received.

`mouseDown`, `updateEvt`, `activateEvt` and `osEvt` events are of significance to the windows aspects of this demonstration. `keyDown` events are significant only with regard to File and Window menu keyboard equivalents.

### **doMouseDown**

`doMouseDown` continues the processing of `mouseDown` events, switching according to the part code.

The `inContent` case results in a call to `SelectWindow` if the window in which the mouse-down occurred is not the front window. `SelectWindow`

- Unhighlights the currently active window, brings the specified window to the front and highlights it.
- Generates activate events for the two windows.
- Moves the previously active window to a position immediately behind the specified window.

The `inDrag` case results in a call to `DragWindow`, which retains control until the user releases the mouse button. The third parameter in the `DragWindow` call establishes the limits, in global screen coordinates, within which the user is allowed to drag the window. In Carbon, `NULL` may be passed in this parameter. This has the effect of setting the third parameter to the bounding rectangle of the desktop region (also known as the “gray region”).

The `inGoAway` case results in a call to `TrackGoAway`, which retains control until the user releases the mouse button. If the pointer is still within the close box/button when the mouse button is released, the function `doCloseWindow` is called.

At the `inGrow` case, the first three lines establish the resizing constraints. The top and left fields of the `Rect` variable `constraintRect` are assigned values representing the minimum height and width to which the window may be resized. The bottom and right fields, which establish the maximum height and width, are assigned the maximum possible `SInt16` value. (Since the mouse cursor cannot be moved beyond the edges of the screen (or screens in a multimonitor system), these values mean that the window can be resized larger to the limits of mouse cursor movement.)

`ResizeWindow` retains control until the user releases the mouse button. When the mouse button is released, `ResizeWindow` redraws the window frame (that is, all but the content region) in the new size and, where window height and/or width has been increased, adds the newly exposed areas of the content region to update region (on Mac OS 8/9). (Note that, in Carbon, the fourth (newContentRect) parameter may be set to `NULL` if the new dimension of the window’s content region is not required.)

The call to `ResizeWindow` is bracketed by two calls to the function `doInvalidateScrollBarArea`. In this program, scroll bars are not used but it has been decided to, firstly, limit update drawing to the window’s content region less the areas normally occupied by scroll bars and, secondly, to use `DrawGrowIcon` to draw the draw scroll bar delimiting lines. (For Mac OS 8/9, this is the usual practice for windows with a size box but no scroll bars. The `DrawGrowIcon` call is ignored on Mac OS X.)

The first call to `doInvalidateScrollBarArea` is necessary to cater for the case where the window is resized larger. If this call is not made, the scroll bar areas prior to the resize will not be redrawn by the window updating function unless these areas are programmatically added to the new update region created by the Window Manager as a result of the resizing action.

The second call to `doInvalidateScrollBarArea` is necessary to cater for the case where the window is resized smaller. This call works in conjunction with the `EraseRgn` call in the function `doUpdateWindow`. The call to `doInvalidateScrollBarArea` results in an update event being generated, and the call to `EraseRgn` in the `doUpdateWindow` function causes the update region (that is, in this case, the scroll bar areas) to be erased. (Remember that, on Mac OS 8/9, between the calls to `BeginUpdate` and `EndUpdate`, the visible region equates to the update region and that `QuickDraw` limits its drawing to the update region.)

At the `inZoomIn/inZoomOut` case, the first action is to assign the desired height and width of the window's standard state content region to the fields of a `Point` variable. This variable is then passed in the second parameter of a call to `IsWindowInStandardState`, which sets the variable `zoomPart` to either true or false depending on whether the window is currently in the standard state or the user state. `TrackBox` is then called, taking control until the user releases the mouse button. If the mouse button is released while the pointer is still within the zoom box, `ZoomWindowIdeal` is called to zoom the window in accordance with human interface guidelines. The second parameter tells `ZoomWindow` whether to zoom out to the standard state or in to the user state.

## **doUpdate**

On Mac OS 8/9 and Mac OS X, an update event will be received

- When the window is created
- When the window is resized larger
- When the window is resized smaller (because of calls to `InvalWindowRect` in the function `doInvalidateScrollBarArea`)
- When the window is zoomed

On Mac OS 8/9, update events will also be received when a window has a non-empty update region

`doUpdate` attends to basic window updating. On Mac OS 8/9, the call to `BeginUpdate` clips the visible region to the intersection of the visible region and the update region. The visible region is now a sort of proxy for the update region. The graphics port is then set before the function `doUpdateWindow` is called to redraw the content region. On Mac OS 8/9, the `EndUpdate` call restores the window's true visible region. (The calls to `BeginUpdate` and `EndUpdate` are ignored on Mac OS X.)

## doUpdateWindow

doUpdateWindow is concerned with redrawing the window's contents less the scroll bar areas.

The first action is to retrieve the window object reference from the message field of the event structure.

The next block retrieves the handle to the window's visible region, following which EraseRgn is called for reasons explained at doMouseDown.

The window's graphics port's bounding rectangle is then retrieved, following which the right and bottom fields are adjusted to exclude the scroll bar areas. The next four lines fill this rectangle with a plain color pattern provided by a 'ppat' resource, simply as a means of proving the correctness of the window updating process.

Note the call to GetWRefCon, which retrieves the window's reference constant stored in the window object. As will be seen, whenever a new window is opened, a value between 1 and kMaxWindows is stored as a reference constant in the window object. In this function, this is just a convenient number to be added to the base resource ID (128) in the single parameter of the GetPixPat call, ensuring that FillRect has a different pixel pattern to draw in each window.

The call to DrawGrowIcon draws the scroll bar delimiting lines (on Mac OS 8/9). Note that this call, the preceding EraseRgn call, and the calls to doInvalidateScrollbarArea are made for "cosmetic" purposes only and would not be required if the window contained scroll bars.

If the program is running on Mac OS 8/9, the remaining lines draw two rectangles and some text in the windows to visually represent to the user the otherwise invisible "hot rectangles" defined in the 'hrct' resource and associated with the window by the 'hwin' resource. When Show Balloons is chosen from the Help menu, the help balloons will be invoked when the cursor moves over these rectangles.

## doActivate

doActivate attends to those aspects of window activation not handled by the Window Manager.

The modifiers field of the event structure is tested to determine whether the window in question is being activated or deactivated. The result of this test is passed as a parameter in the call to the function doActivateWindow.

## doActivateWindow

In this demonstration, the remaining actions carried out in response to an activateEvt are limited to placing/removing checkmarks in/from items in the Window menu.

The first step is to associate the received WindowRef with its item number in the Window menu. At the while loop, the array maintained for that purpose is searched until a match is

found. The array element number at which the match is found correlates directly with the menu item number; accordingly, this is assigned to the variable `menuItem`, which is used in the following `CheckMenuItem` calls. Whether the checkmark is added or removed depends on whether the window in question is being activated or deactivated, a condition passed to the call to `doActivateWindow` as its second parameter.

The call to `DrawGrowIcon` ensures that the scroll bar area delimiting lines will be drawn in gray when the window is deactivated (on Mac OS 8/9).

### **doOSEvent**

`doOSEvent` handles operating system events. In this demonstration, action is taken only in the case of resume events. If the event is a resume event, the cursor is set to the arrow shape.

### **doMenuChoice and doFileMenu**

`doMenuChoice` switches according to the menu choices of the user. `doFileMenu` switches according to the File menu item choice of the user.

### **doWindowsMenu**

`doWindowsMenu` takes the item number of the selected Window menu item and, because this equates to the number of the array element in which the associated window object reference is stored, extracts the window object reference associated with the menu item. This is used in the call to `SelectWindow`, which generates the `activateEvts` required to activate and deactivate the appropriate windows.

### **doNewWindow**

`doNewWindow` opens a new window and attends to associated tasks.

In the first block, if the current number of open windows equals the maximum allowable specified by `kMaxWindows`, a caution movable modal alert is called up via the function `doErrorAlert` (with the string represented by `eMaxWindows displayed`) and an immediate return is executed when the user clicks the alert's OK button.

At the next block, the new window is created by the call to `GetNewCWindow`. The third parameter specifies that the window is to be opened in front of all other windows. If the call is not successful for any reason, a stop movable modal alert is called up via the function `doErrorAlert` (with the string represented by `eFailWindow displayed`) and the program terminates when the user clicks the alert's OK button.

The next seven lines create the string which will be used to set the window's title. The code reflects the fact that Aqua Human Interface Guidelines require that a number only be appended to "untitled" for the second and later windows. Accordingly, concatenating a number to the string "untitled" is not affected for the first window created.



`GetIndString` retrieves the string “untitled” from the specified 'STR#' resource and the global variable which keeps track of the numbers for the title bar is incremented. If this is not the first window to be created, `NumToString` converts that number to a Pascal string and this string is concatenated to the “untitled” string. The `SetWTitle` call then sets the window's title.

The next block sets adjusts the size of the window before it is displayed. The width is set to 460 pixels and the height is adjusted according to the available screen real estate.

The call to `GetAvailableWindowPositioningBounds` returns, in global coordinates, the available real estate on the main screen (device). This excludes the menu bar and, on Mac OS X, the Dock. The call to `SetPortWindowPort` sets the window's graphics port as the current port, a necessary precursor to the call to `LocalToGlobal`, which converts the top-left (local) coordinates of the port rectangle to global coordinates. The height of the rectangle returned by `GetAvailableWindowPositioningBounds` is then reduced by the distance of the top of the port rectangle from the top of the screen, and then further reduced by three. On Mac OS X, this will cause the bottom of the window to be just above the top of the Dock. If the program is running on Mac OS 8/9, the height is reduced by a further 27 pixels to accommodate the height of the control strip. The call to `SizeWindow` sets the window's size. (The window's location is determined by the positioning specification in the window's 'WIND' resource.)

The `ShowWindow` call makes the window visible.

The next block adds the metacharacter \ and the window number to the string used to set the window title (thus setting up the Command key equivalent) before `InsertMenuItem` is called to create a new menu item to the Window menu. Note that the Command-key equivalent is only added for the first nine windows opened.)

The `SetWRefCon` call stores the value represented by `gCurrentNumberOfWindows` in the window object as the window's reference constant. As previously stated, in this demonstration this is used to select a pixel pattern to draw in each window's content region.

At the next two lines, the variable which keeps track of the current number of opened windows is incremented and the appropriate element of the window reference array is assigned the reference to newly opened window's window object.

The last block enables the Window menu and the Close item in the File menu when the first window is opened.

### **doCloseWindow**

The function `doCloseWindow` closes an open window and attends to associated tasks.

At the first two lines, a reference to the frontmost window's window object is retrieved and passed in the call to `DisposeWindow`. `DisposeWindow` removes the window from the screen, removes it from the window list, and discards all its data storage. With the window closed, the global variable that keeps track of the number of windows currently open is decremented.

The next block deletes the associated menu item from the Window menu. At the first four lines, the array element in which the window object reference in question is located is searched out, the element number (which correlates directly with the menu item number) is noted and the element is set to NULL. The call to `DeleteMenuItem` then deletes the menu item.

The for loop “compacts” the array, that is, it moves the contents of all elements above the NULLed element down by one, maintaining the correlation with the Windows menu.

The last block disables the Windows menu and the Close item in the File menu if no windows remain open as a result of this closure.

### **doInvalidateScrollBarArea**

`doInvalidateScrollBarArea` invalidates that part of the window’s content area which would ordinarily be occupied by scroll bars. The function simply retrieves the coordinates of the content area into a local `Rect` and reduces this `Rect` to the relevant scroll bar area before invalidating that area, that is, adding it to the window’s update region.

### **doConcatPStrings**

The function `doConcatPStrings` concatenates two Pascal strings.

### **doErrorAlert and eventFilter**

`doErrorAlert` displays either a caution alert or a stop alert with a specified string (two strings in the case of the `eMaxWindows` error) extracted from the 'STR#' resource identified by `rStringList`. `eventFilter` supports `doErrorAlert`.

The creation of alerts using the `StandardAlert` function, and event filter functions, are addressed in Chapter 8.

# Carbon and Universal Procedure Pointers

## CHAPTER

# 5

## IN THIS CHAPTER

- Introduction 212
- The 68LC040 Emulator and the Mixed Mode Manager 213
- Universal Procedure Pointers and Carbon 216
- Creation/Disposal Functions Relevant to Demonstration Programs 217

## Introduction

Previous demonstration programs have called a function (`AEInstallEventHandler`) which takes a **universal procedure pointer** as a parameter; however, an explanation of this term has been delayed until this chapter because the `AEInstallEventHandler` calls were only incidental to the main purpose of those demonstrations. The demonstration programs in Chapter 7 are the first in which calls to a system software function which takes a universal procedure pointer as a parameter are central to the demonstration. As a brief but necessary prelude for what is to come, therefore, this chapter addresses the role of universal procedure pointers in the general scheme of things, when and why they were introduced, and their relevance in the Carbon environment.

In a sense, universal procedure pointers are a piece of historical baggage dragged into Carbon by Mac OS 8/9. They were first introduced with the so-called Universal Headers which, in turn, were introduced with the Power Macintosh. They had to do with the ability of the Power Macintosh to run applications that use the instruction set of the Motorola 680x0 microprocessor (used in 680x0-based Macintoshes) as well as applications that use the native instruction set of the Power Macintosh's PowerPC microprocessor.

In the Chapter 7 demonstration programs, the system software function that takes a universal procedure pointer is `TrackControl`. This function is called by your application when a mouse-down event occurs in a control, such as a scroll bar. Prior to the introduction of the Power Macintosh and the associated introduction of the Universal Headers, the `TrackControl` prototype looked like this:

```
Sint16 TrackControl(ControlHandle theControl, Point localPoint,
                   ProcPtr actionProc);
```

The `actionProc` parameter is simply the address of an application-defined function, called a **callback procedure** (or, in C terminology, a **callback function**) that is called repeatedly while the mouse button remains down. In other words, the `TrackControl` function used to take a **procedure pointer** (or, in C terminology, a **function pointer**) in its `actionProc` parameter.

The Universal Headers, which allow you to write Classic API source code capable of being compiled as either 680x0 code or native PowerPC code, changed the prototype for `TrackControl` to

```
ControlPartCode TrackControl(ControlHandle theControl, Point startPoint,
                             ControlActionUPP actionProc);
```

Notice that the third parameter is now of type `ControlActionUPP`. This means that the `actionProc` parameter now takes a **universal procedure pointer**. This prototype has been carried through to Carbon, hence the necessity to gain a basic understanding of universal procedure pointers.

# The 68LC040 Emulator and the Mixed Mode Manager

## The Emulator

The ability of the Mac OS 8/9 system software to execute applications that use the instruction set of the Motorola 680x0 microprocessor as well as applications that use the native instruction set of the PowerPC microprocessor is provided by an **emulator** (the 68LC040 Emulator). The emulator, which is essentially a 680x0 microprocessor implemented in software, provides an execution environment that is virtually identical to the execution environment found on 680x0-based Macintoshes.

One important aspect of the 68LC040 emulator is that it made it possible for parts of the system software to remain as 680x0 code while other parts were progressively rewritten, primarily for reasons of speed, as native PowerPC code. In this regard, it is important to understand that some of Mac OS 8/9 still remains as 680x0 code. For example, in Mac OS 8.6, parts of the Control Manager (including, possibly, TrackControl) remains in 680x0 code. For the purposes of explanation, the following assumes that, in Mac OS 8/9, TrackControl still exists as 680x0 code.

## The Mixed Mode Manager

In Mac OS 8/9, the emulator works together with a manager called the **Mixed Mode Manager**. The Mixed Mode Manager manages **mode switches** between code in different **instruction set architectures (ISAs)**.

## Mode Switches

In Mac OS 8/9, mode switches are required when an application calls a system software function (or, indeed, any other code) that exists in a different ISA. For example:

- When a PowerPC application invokes a system software function that exists only as 680x0 code, a mode switch is required to move from the native environment to the emulator environment. Then, when that system software function completes, another mode switch is required to return from the emulator to the PowerPC environment to allow the PowerPC application to continue executing.

This situation can occur in a Carbon application running on Mac OS 8/9 because, as previously stated, not all of Mac OS 8/9 has been rewritten as native PowerPC code.

- When a 680x0 application running under the emulator calls a system software function that exists as native PowerPC code, a mode switch is required to move out of the emulator and into the native PowerPC environment. Then, when that system software function

completes, another mode switch is required to return to the emulator and to allow the 680x0 application to continue executing.

This situation cannot occur in a Carbon application running on Mac OS 8/9 because all Carbon applications must be compiled as native PowerPC code.

The Mixed Mode Manager operates transparently to most applications and other types of software, meaning that most **cross-mode calls** (calls to code in a different ISA from the caller's ISA) are detected automatically by the Mixed Mode Manager and handled without intervention by the calling software.

## Intervention in Mode Switching

Sometimes, however, executable code needs to interact directly with the Mixed Mode Manager to ensure that a mode switch occurs at the correct time. When writing native PowerPC code, you only have to intervene in the mode-switching process when you execute code whose ISA might be different from the calling code. For example, when you pass the address of your application-defined action function (native PowerPC code) to `TrackControl` (680x0 code), the ISA of the code whose address you are passing is different from the ISA of the function you are passing it to. In such cases, you must ensure that the Mixed Mode Manager is called to make the necessary mode switch. You do this by explicitly signaling

- The type of code you are passing
- The code's calling conventions

### Indicating the ISA of a Callback Function—Routine Descriptors

You create a **routine descriptor** for a particular function to indicate the ISA of that function. The first field of a routine descriptor (`goMixedModeTrap`) is an executable 680x0 instruction which invokes the Mixed Mode Manager. The Mixed Mode Manager having been called, it inspects the remaining fields of the routine descriptor to determine whether a mode switch is required. The Mixed Mode Manager is particularly interested in the `routineRecords` field.

The `routineRecords` field is an array of **routine structures**, each element of which describes a single function. In the simplest case, the array of routine structures contains a single element.

The `ISA` and `procInfo` fields are the most important fields in a routine structure:

- **ISA Field.** The `ISA` field contains the ISA code of the function being described, and always contains one of these two constants:

```
kM68kISA    = (ISAType) 0    MC680x0 architecture.
KPowerPCISA = (ISAType) 1    PowerPC Architecture.
```

**procInfo Field.** The `procInfo` field contains the function's **function information**, including the function's calling conventions and information about the function's parameters.



## Creating a Routine Descriptor For a Control Action Function

Using the function `NewControlActionUPP`, you can create a routine descriptor for a control action function as follows, in which `myControlAction` is your application-defined control action function:

```
ControlActionUPP myControlActionUPP;  
  
myControlActionUPP = NewControlActionUPP(myControlAction);
```

Notice that the result returned by `NewControlActionUPP` is of type `ControlActionUPP`. The UPP stands for a **universal procedure pointer**, which is defined to be *either* a 680x0 function pointer *or* a pointer to a routine descriptor (hence the term “universal”). Thus, in Mac OS 8/9, the effect of the call to `NewControlActionUPP` depends on whether it is executed in the 680x0 environment or the PowerPC environment:

- In the 680x0 environment, `NewControlActionUPP` simply returns its first parameter—that is, a pointer to your application-defined control action function.
- In the PowerPC environment, `NewControlActionUPP` creates a routine descriptor in your application heap and returns the address of that routine descriptor.

## Effect of the Routine Descriptor

Once you have created the routine descriptor, you can later call `TrackControl` like this:

```
TrackControl(myControl, myPoint, myControlActionUPP);
```

In Mac OS 8/9, if your application is a PowerPC application (as will be the case in Carbon), the value passed in the `myControlActionUPP` parameter is not the address of your action function itself, but the address of the routine descriptor. If a 680x0 version of `TrackControl` executes your action function, it begins by executing the instruction in the first field of the routine descriptor. That instruction invokes the Mixed Mode Manager, which inspects the ISA of the action function (contained in the ISA field of the routine structure). Since that ISA differs from the ISA of the `TrackControl` function, the Mixed Mode Manager causes a mode switch. (Of course, if `TrackControl` existed as PowerPC code, the ISAs would be identical, and the Mixed Mode Manager would simply execute the action function without switching modes.)

In short, you solve the problem of indicating a routine’s ISA by creating a routine descriptor and by using the address of that routine descriptor (that is, a universal procedure pointer) where you would have used the address of the function (that is, a procedure pointer) in the 680x0 programming environment.

## Disposing of Routine Descriptors

Disposing of routine descriptors is only necessary or advisable if you know that you will not be using the descriptor any more during the execution of your application or if you allocate a routine descriptor for temporary use only.

## Functions Requiring Routine Descriptors

Some of the typical functions for which you need to create routine descriptors are

<i>Function Type</i>	<i>Examples Are at the Demonstration Programs Associated With</i>
Control action functions	Chapters 7, 14, 17, and 21
Event filter functions	Chapters 4, 8, 14, and 21
Apple event handling functions	Chapters 10, 18, and 26
Key filter functions	Chapter 14
Edit text validation functions	Chapter 14
User pane drawing functions	Chapters 14 and 21
User pane activate functions	Chapter 14
Carbon event handlers	Chapters 17 to 26
Carbon event timers	Chapter 17, 18, 21, 23, and 26
Navigation Services event handlers	Chapter 18, 21, 23, and 26
TextEdit click loop functions	Chapter 21
List search functions	Chapter 22
List definition functions	Chapter 22
Drag and drop functions (various)	Chapter 23
Device loop drawing functions	Chapter 25

## Universal Procedure Pointers and Carbon

Carbon supports universal procedure pointers transparently. By using the system-supplied universal procedure pointer functions, your application will operate correctly in both the Mac OS 8/9 and Mac OS X environments.

On Mac OS 8/9, the universal procedure pointer creation functions allocate routine descriptors in memory just as you would expect. On Mac OS X, the implementation of universal procedure pointers depends on various factors, including the object file format you choose.

Universal procedure pointers will allocate memory if your application is compiled as a CFM binary, but are likely to return a simple procedure pointer if your application is compiled as a Mach-O binary. (All demonstration programs in this book are compiled as CFM binaries so that they will run on both Mac OS 8/9 and Mac OS X. Mach-O binaries only run on Mac OS X.)

In Carbon, routine descriptors must be disposed of using the specific disposal function associated with the creation function. For example, routine descriptors created with `NewControlActionUPP` must be disposed of using `DisposeControlActionUPP`. The generic disposal function `DisposeRoutineDescriptor` is not supported in Carbon.

## Creation/Disposal Functions Relevant to Demonstration Programs

### Creating Routine Descriptors

<code>ControlActionUPP</code>	<code>NewControlActionUPP(ControlActionProcPtr userRoutine);</code>
<code>ModalFilterUPP</code>	<code>NewModalFilterUPP(ModalFilterProcPtr userRoutine);</code>
<code>AEEEventHandlerUPP</code>	<code>NewAEEEventHandlerUPP(AEEEventHandlerProcPtr userRoutine);</code>
<code>ControlKeyFilterUPP</code>	<code>NewControlKeyFilterUPP(ControlKeyFilterProcPtr userRoutine);</code>
<code>ControlEditTextValidationUPP</code>	<code>NewControlEditTextValidationUPP(ControlEditTextValidationProcPtr userRoutine);</code>
<code>ControlUserPaneDrawUPP</code>	<code>NewControlUserPaneDrawUPP(ControlUserPaneDrawProcPtr userRoutine);</code>
<code>ControlUserPaneActivateUPP</code>	<code>NewControlUserPaneActivateUPP(ControlUserPaneActivateProcPtr userRoutine);</code>
<code>TEClickLoopUPP</code>	<code>NewTEClickLoopUPP(TEClickLoopProcPtr userRoutine);</code>
<code>ListSearchUPP</code>	<code>NewListSearchUPP(ListSearchProcPtr userRoutine);</code>
<code>ListDefUPP</code>	<code>NewListDefUPP(ListDefProcPtr userRoutine);</code>
<code>DragTrackingHandlerUPP</code>	<code>NewDragTrackingHandlerUPP(DragTrackingHandlerProcPtr userRoutine);</code>
<code>DragReceiveHandlerUPP</code>	<code>NewDragReceiveHandlerUPP(DragReceiveHandlerProcPtr userRoutine);</code>
<code>DragSendDataUPP</code>	<code>NewDragSendDataUPP(DragSendDataProcPtr userRoutine);</code>
<code>DragInputUPP</code>	<code>NewDragInputUPP(DragInputProcPtr userRoutine);</code>
<code>DragDrawingUPP</code>	<code>NewDragDrawingUPP(DragDrawingProcPtr userRoutine);</code>
<code>DeviceLoopDrawingUPP</code>	<code>NewDeviceLoopDrawingUPP(DeviceLoopDrawingProcPtr userRoutine);</code>

### Disposing of Routine Descriptors

```
void DisposeControlActionUPP(ControlActionUPP userUPP);
void DisposeModalFilterUPP(ModalFilterUPP userUPP);
void DisposeAEEEventHandlerUPP(AEEEventHandlerUPP userUPP);
void DisposeControlKeyFilterUPP(ControlKeyFilterUPP userUPP);
void DisposeControlEditTextValidationUPP(ControlEditTextValidationUPP userUPP);
void DisposeControlUserPaneDrawUPP(ControlUserPaneDrawUPP userUPP);
void DisposeControlUserPaneActivateUPP(ControlUserPaneActivateUPP userUPP);
void DisposeTEClickLoopUPP(TEClickLoopUPP userUPP);
void DisposeListSearchUPP(ListSearchUPP userUPP);
void DisposeListDefUPP(ListDefUPP userUPP);
void DisposeDragTrackingHandlerUPP(DragTrackingHandlerUPP userUPP);
void DisposeDragReceiveHandlerUPP(DragReceiveHandlerUPP userUPP);
void DisposeDragSendDataUPP(DragSendDataUPP userUPP);
void DisposeDragInputUPP(DragInputUPP userUPP);
void DisposeDragDrawingUPP(DragDrawingUPP userUPP);
void DisposeDeviceLoopDrawingUPP(DeviceLoopDrawingUPP userUPP);
```



# The Appearance Manager

## CHAPTER

# 6

## IN THIS CHAPTER

- History 220
- The Appearance Manager 222
- Main Constants, Data Types, and Functions 229
- Demonstration Program Appearance Listing 231
- Demonstration Program Appearance Comments 242

## History

The Appearance Manager, which was first introduced with Mac OS 8.0, had implications for the Menu Manager, the Window Manager, the Control Manager, and the Dialog Manager. The relatively minor implications in respect of the Menu Manager and Window Manager were incorporated into Chapter 3 and Chapter 4. The most profound impact of the Appearance Manager, however, has been in the area of user interface objects known as **controls**, which are addressed in Chapters 7 and 14. Accordingly, as a preparation for what is to come, this chapter now formally introduces the Appearance Manager, a component of the system software which, on Mac OS 8/9, represented the most significant improvement in the Macintosh user experience since the introduction of System 7.

Although introduced with Mac OS 8.0, the Appearance Manager's full impact on the Macintosh user experience was not scheduled to be realized until the release of Mac OS 8.5. Mac OS 8.5 was to be the first release to include several switchable **themes**, one of which (the Platinum theme) had, in fact, been included in Mac OS 8.0. The concept of switchable themes was the main driving force behind the creation of the Appearance Manager.

Essentially, a theme was intended to be an interface “look” that spanned all elements of the user interface (windows, menus, dialogs, controls, background colors, alert icons, and so on), tying them together with a certain graphic design. Fig 1 shows the same window as it would have appeared in the three themes originally intended to be included in Mac OS 8.5. If one of these themes had been selected by the user, all elements of the user interface (menus, windows, controls) would have appeared in that theme.

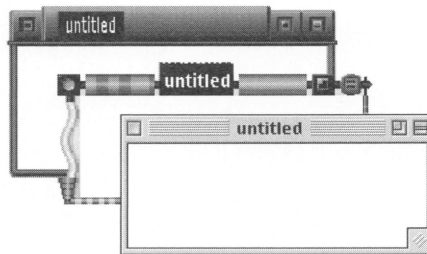


FIG 1 - WINDOWS IN THREE THEMES

The two additional themes (High Tech and Gizmo) shown in Fig 1 were included in prerelease versions of Mac OS 8.5; however, prior to final release, these two themes were deleted. The reasons for this decision by Apple remain tantalizingly obscure.



## Themes—New Definition

Mac OS 8.5 did, in fact, introduce a theme scheme, though one of an entirely different flavor to that described above. This is reflected in the Appearance control panel introduced with Mac OS 8.5, in which the Platinum *theme* is now referred to as the Platinum *appearance*. An appearance (new definition) is now simply one component of a broader set of user preferences known as a theme (new definition). With the release of Mac OS 8.5, therefore, the term “theme” took on an entirely new meaning.

On Mac OS 8/9, in Mac OS 8.5 and later, an individual theme is a set of user preferences encompassing

- An appearance (which unifies the look of human interface objects such as windows, dialogs, alerts, menus, controls, and so on), together with a highlight color (for selected text) and a variation color (for menus and controls). (As of Mac OS 9.1, Platinum remains the only appearance ever provided by Apple. It is by now certain that this situation will never change.)
- A large system font (for menus and headings), a small system font (for explanatory text and labels), a views font (for lists and icons), and an option to turn anti-aliasing of fonts on screen on or off.
- A desktop picture and desktop pattern.
- Sound preferences relating to opening menus and choosing items, dragging and resizing windows, interacting with controls, and clicking, dragging, and dropping in the Finder.
- Scrolling preference (smart scrolling on or off) and collapse-window preference (double-click title bar to collapse window on or off).

## Theme-Compliance

Another significant terminological change ushered in by Mac OS 8.5 was that, whereas Apple documentation previously spoke of making applications **appearance-compliant**, documentation released following the release of Mac OS 8.5 spoke of making applications **theme-compliant**. It is assumed that the reason for this change is that, while the vast bulk of the measures required to make an application theme-compliant relate to unifying the look of the application’s Mac OS 8/9 user interface elements (the province of an appearance), there are additional measures that the application may take, or may have to take:

- In response to the user changing the system and/or views fonts, using the Fonts tab of the Appearance control panel, while the application is running. (This consideration does not apply if the application uses standard human interface elements (that is, system-defined

windows, controls, and menus), since the fonts used for these elements automatically change with the theme change. However, some applications may use custom human interface elements and may, for example, draw their own text in a dialog. In such cases, the application must ensure that the fonts used match the corresponding system fonts in the current theme.)

- To cause theme-compliant sounds to accompany, for example, the opening and closing of the application's windows and the manipulation by the user of custom human interface elements.
- To support the proportional scroll boxes the user expects when Smart Scrolling is selected on in the Options tab of the Appearance control panel.

#### NOTE

Proportional scroll boxes are scroll boxes which vary in size according to the proportion of the document visible in the window.

## The Appearance Manager

The influence of the Appearance Manager is evident to a greater or lesser extent in many chapters of this book and in all of the associated demonstration programs. Among other things, it ensures consistency in the appearance of the standard human interface elements on both Mac OS 8/9 and Mac OS X. It also provides the means to

- Ensure that the appearance of your application's custom human interface elements (if any) is consistent with the Platinum and Aqua "look."
- Draw anti-aliased text on Mac OS X.

Carbon fully supports the Appearance Manager.

## New Definition Functions—Mac OS 8/9

To provide a system-wide coordination of look and behavior on Mac OS 8/9, new theme-compliant definition functions were introduced with the Appearance Manager to replace the old pre-Appearance Manager definition functions for menu bars, menus, windows, and controls. In addition, many new theme-compliant control definition functions for new types of controls (slider controls, focus rings, group boxes, and so on) were introduced to obviate the necessity for developers to provide their own.

## Colors, Patterns, and Appearance Primitives

The Appearance Manager provides **Appearance primitives**, and the means to set the colors and patterns, needed to draw consistently in the Platinum appearance on Mac OS 8/9 and with the Aqua “look” on Mac OS X. Using these drawing primitives, colors, and patterns makes it easier to create visual entities and custom human interface elements that are consistent with the Platinum appearance and Aqua “look.”

### Drawing Appearance Primitives

As will become apparent in Chapters 7 and 14, most of the Appearance primitives relate to certain controls. The definition functions for these controls call these primitives when drawing the relevant control. For example, the control definition function for a primary group box calls the primitive `DrawThemePrimaryGroup` to draw the visual representation of that control.

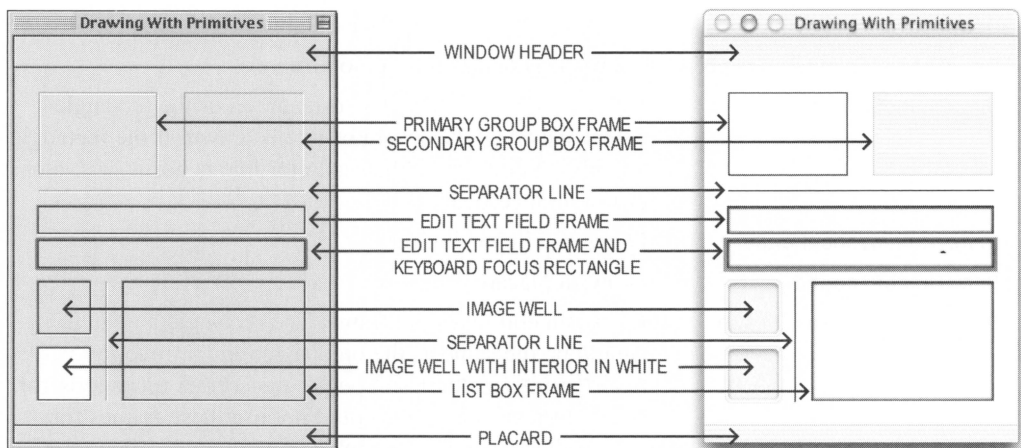
Your application might use these primitives to, for example, draw an image of a placard, window header, or edit text field frame, when you don’t want to use a control.

The following are examples of functions that draw Appearance primitives:

<i>Function</i>	<i>Description</i>
<code>DrawThemePrimaryGroup</code>	Draws a primary group box frame.
<code>DrawThemeSecondaryGroup</code>	Draws a secondary group box frame.
<code>DrawThemeSeparator</code>	Draws a separator line. The orientation of the rectangle determines how the separator line is drawn. If the rectangle is wider than it is tall, the separator line is horizontal; otherwise it is vertical.
<code>DrawThemeWindowHeader</code>	Draws a window header.
<code>DrawThemePlacard</code>	Draws a placard.
<code>DrawThemeEditTextFrame</code>	Draws an edit text field frame. The rectangle passed in should be the same as the one passed in the function <code>DrawThemeFocusRect</code> so you get the correct focus look for your edit text field. You should not use these frames for items other than edit text fields.
<code>DrawThemeListBoxFrame</code>	Draws a list box frame. The rectangle passed in should be the same as the one passed into the function <code>DrawThemeFocusRect</code> so that you get the correct focus look for your list box.

<i>Function</i>	<i>Description</i>
<code>DrawThemeFocusRect</code>	Draws or erases a focus ring around a specified rectangle. To achieve the right look, you should first call <code>DrawThemeEditTextFrame</code> or <code>DrawThemeListBoxFrame</code> and then call <code>DrawThemeFocusRect</code> , passing the same rectangle in the <code>inRect</code> parameter. If you use <code>DrawThemeFocusRect</code> to erase the focus ring around an edit text field frame or list box frame, you will have to redraw the edit text field frame or list box frame because there is typically an overlap.
<code>DrawThemeGenericWell</code>	Draws an image well frame. You can specify that the center of the well be filled with white (Mac OS 8/9).
<code>DrawThemeFocusRegion</code>	Draws or erases a focus ring around a specified region.
<code>DrawThemeTabPane</code>	Draws a tab-pane.
<code>DrawThemeTab</code>	Draws a tab.

Fig 2 shows examples of images drawn in the active mode using the Appearance primitives.



**FIG 2 - IMAGES DRAWN WITH APPEARANCE DRAWING PRIMITIVES**

### Draw State Constants

The following constants are passed in the `inState` parameter of the functions that draw Appearance primitives (except `DrawThemeFocusRect` and `DrawThemeFocusRegion`) to specify whether the primitive should be drawn in the active or deactivated mode.

(`DrawThemeFocusRect` and `DrawThemeFocusRegion` either draw or erase the focus rectangle depending on whether `true` or `false` is passed in the `inHasFocus` parameter.)

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kThemeStateInactive</code>	0	Draw the primitive in the inactive mode
<code>kThemeStateActive</code>	1	Draw the primitive in the active mode

Another draw state constant (`kThemeStatePressed`) is available to draw certain primitives in the pressed mode; however, the primitives listed above can only be drawn in the active and inactive modes.

## Drawing in Colors and Patterns Consistent with the Platinum Appearance and Aqua “Look”

The following functions are those used to draw using colors/patterns consistent with the Platinum appearance and Aqua “look”. (Patterns are explained in Chapter 11.) The reference to colors *and* patterns reflects the fact that either a color or a pattern may be used for the drawing.

<i>Function</i>	<i>Description</i>
<code>SetThemeWindowBackground</code>	Sets the color/pattern that the window background will be repainted to when <code>PaintOne</code> is called. This function sets the color/pattern to which the Window Manager will erase the window background.  See the Brush Type Constants.
<code>SetThemeBackground</code>	Sets an element’s background color/pattern to comply with the Platinum appearance/Aqua “look.” This function should be called each time you wish to draw an element in a specified brush constant using Appearance Manager draw functions.  See the Brush Type Constants.
<code>SetThemePen</code>	Sets an element’s pen pattern or color to comply with the Platinum appearance/Aqua “look.” This function should be called each time you wish to draw an element in a specified brush constant using Appearance Manager draw functions.  See the Brush Type Constants.
<code>SetThemeTextColor</code>	Sets an element’s foreground color for drawing text to comply with the Platinum appearance/Aqua “look.”  See the Text Color Constants.

## Brush Type Constants

The following are examples of constants, of type `ThemeBrush`, which may be passed in the `inBrush` parameter of calls to `SetThemeWindowBackground`, `SetThemeBackground`, and `SetThemePen` to specify colors/patterns for user interface elements. For reasons explained above, these constants can represent either a straight color or a pattern.

<i>Constant</i>	<i>Description</i>
<code>kThemeBrushDialogBackgroundActive</code>	An active dialog's background color/pattern.
<code>kThemeBrushDialogBackgroundInactive</code>	An inactive dialog's background color or pattern.
<code>kThemeBrushAlertBackgroundActive</code>	An active alert's background color/pattern.
<code>kThemeBrushAlertBackgroundInactive</code>	An inactive alert's background color/pattern.
<code>kThemeBrushModelessDialogBackgroundActive</code>	An active modeless dialog's background color/pattern.
<code>kThemeBrushModelessDialogBackgroundInactive</code>	An inactive modeless dialog's background color/pattern.
<code>kThemeBrushUtilityWindowBackgroundActive</code>	An active utility window's background color/pattern.
<code>kThemeBrushUtilityWindowBackgroundInactive</code>	An inactive utility window's background color/pattern.
<code>kThemeBrushListViewSortColumnBackground</code>	The background color/pattern of the column upon which a list view is sorted. (Applicable on Mac OS 8/9 only.)
<code>kThemeBrushListViewBackground</code>	The background color/pattern of a list view column that is not being sorted upon. (Applicable on Mac OS 8/9 only.)
<code>kThemeBrushListViewSeparator</code>	A list view separator's color/pattern. (Applicable on Mac OS 8/9 only.)
<code>kThemeBrushDocumentWindowBackground</code>	A document window's background color/pattern.



## Text Color Constants

Constants of type `ThemeTextColor` may be passed in the `inColor` parameter of the function `SetThemeTextColor` to specify theme-compliant text colors for user interface elements in their active, inactive, and highlighted states. Some of these constants are as follows:

<i>Constant</i>	<i>Description</i>
<code>kThemeTextColorWindowHeaderActive</code>	Text color for active window header.
<code>kThemeTextColorWindowHeaderInactive</code>	Text color for inactive window header.
<code>kThemeTextColorPlacardActive</code>	Text color for active placard.
<code>kThemeTextColorPlacardInactive</code>	Text color for inactive placard.
<code>kThemeListViewTextColor</code>	Text color for list view. (Applicable on Mac OS 8/9 only.)

## Appearance Manager Text

The Appearance Manager function `UseThemeFont` may be used to set the font for the current graphics port.

Text drawn on Mac OS X using QuickDraw functions such as `DrawString` is not entirely satisfactory. You should therefore use the Appearance Manager function `DrawThemeTextBox` to draw text when your application is running on Mac OS X.

You pass a value of type `ThemeFontID` in the `inFontID` parameter of `UseThemeFont` and `DrawThemeTextBox`. The principal relevant constants are as follows:

<i>Constant</i>	<i>Font on Mac OS 8/9</i>	<i>Font on Mac OS X</i>
<code>kThemeSystemFont</code>	As set in Appearance control panel.	Lucida Grande Regular 13pt
<code>kThemeEmphasizedSystemFont</code>	System font, as set in Appearance control panel.	Lucida Grande Bold 13pt
<code>kThemeSmallSystemFont</code>	As set in Appearance control panel.	Lucida Grande Regular 11pt
<code>kThemeSmallEmphasizedSystemFont</code>	Small system font, as set in Appearance control panel, bold.	Lucida Grande Bold 11pt
<code>kThemeApplicationFont</code>	Geneva 12pt.	Lucida Grande Regular 13pt
<code>kThemeLabelFont</code>	System font, as set in Appearance control panel.	Lucida Grande Regular 10pt

## Saving and Setting the Graphics Port Drawing State

Chapter 12 addresses certain measures which need to be taken consequential to the fact that both colors and patterns can be used by the Appearance functions `SetThemeWindowBackground`, `SetThemeBackground`, and `SetThemePen`. These measures have to do with saving, restoring, and normalizing the drawing state of the graphics port. The associated functions are as follows:

<i>Constant</i>	<i>Description</i>
<code>GetThemeDrawingState</code>	Obtain the drawing state of the current graphics port.
<code>SetThemeDrawingState</code>	Set the drawing state of the current graphics port.
<code>NormalizeThemeDrawingState</code>	Set the current graphics port to the default drawing state.
<code>DisposeThemeDrawingState</code>	Release the memory associated with a reference to a graphics port's drawing state.

## Cursor Setting

The Appearance Manager introduced the following cursor-setting functions, the uses of which are addressed in Chapter 13:

<i>Constant</i>	<i>Description</i>
<code>SetThemeCursor</code>	Sets the cursor.
<code>SetAnimatedThemeCursor</code>	Sets an animated cursor.

## Getting Menu Bar Height

The Appearance Manager introduced the function `GetThemeMenuBarHeight`. In most instances, the value returned by this function and `GetMBarHeight` are the same. However, when the menu bar is hidden, `GetMBarHeight` produces a value of 0, whereas `GetThemeMenuBarHeight` still returns the height of the (hidden) menu bar.

## Appearance Manager Apple Events

On Mac OS 8/9, your application may need to respond to the user changing the system and/or views fonts using the Fonts tab in the Appearance control panel. Your application is advised of font changes via **Appearance Manager Apple events**. Appearance Manager Apple events are addressed in Chapter 10.

## Carbon Note

Prior to CarbonLib 1.1, it was necessary to call `RegisterAppearanceClient` at program launch in order for your application to receive Appearance Manager Apple events. However, in CarbonLib 1.1 and later, the CarbonLib initialization routine calls `RegisterAppearanceClient` on behalf of your application, and there is thus no requirement for your application to call this function.

# Main Constants, Data Types, and Functions

## Constants

### Theme-Compliant Brush Type Constants

<code>kThemeBrushDialogBackgroundActive</code>	= 1
<code>kThemeBrushDialogBackgroundInactive</code>	= 2
<code>kThemeBrushAlertBackgroundActive</code>	= 3
<code>kThemeBrushAlertBackgroundInactive</code>	= 4
<code>kThemeBrushModelessDialogBackgroundActive</code>	= 5
<code>kThemeBrushModelessDialogBackgroundInactive</code>	= 6
<code>kThemeBrushUtilityWindowBackgroundActive</code>	= 7
<code>kThemeBrushUtilityWindowBackgroundInactive</code>	= 8
<code>kThemeBrushListViewSortColumnBackground</code>	= 9
<code>kThemeBrushListViewBackground</code>	= 10
<code>kThemeBrushListViewSeparator</code>	= 12
<code>kThemeBrushDocumentWindowBackground</code>	= 15
<code>kThemeBrushFinderWindowBackground</code>	= 16
<code>kThemeBrushBlack</code>	= -1
<code>kThemeBrushWhite</code>	= -2

### Theme-Compliant Text Color Constants

<code>kThemeTextColorWindowHeaderActive</code>	= 7
<code>kThemeTextColorWindowHeaderInactive</code>	= 8
<code>kThemeTextColorPlacardActive</code>	= 9
<code>kThemeTextColorPlacardInactive</code>	= 10
<code>kThemeTextColorPlacardPressed</code>	= 11
<code>kThemeTextColorListView</code>	= 22
<code>kThemeTextColorBlack</code>	= -1
<code>kThemeTextColorWhite</code>	= -2

### Theme-Compliant Draw State Constants (For Primitives)

<code>kThemeStateInactive</code>	= 0
<code>kThemeStateActive</code>	= 1
<code>kThemeStatePressed</code>	= 2

## Theme Cursor Constants

kThemeArrowCursor	= 0	
kThemeCopyArrowCursor	= 1	
kThemeAliasArrowCursor	= 2	
kThemeContextualMenuArrowCursor	= 3	
kThemeIBeamCursor	= 4	
kThemeCrossCursor	= 5	
kThemePlusCursor	= 6	
kThemeWatchCursor	= 7	Can animate
kThemeClosedHandCursor	= 8	
kThemeOpenHandCursor	= 9	
kThemePointingHandCursor	= 10	
kThemeCountingUpHandCursor	= 11	Can animate
kThemeCountingDownHandCursor	= 12	Can animate
kThemeCountingUpAndDownHandCursor	= 13	Can animate
kThemeSpinningCursor	= 14	Can animate
kThemeResizeLeftCursor	= 15	
kThemeResizeRightCursor	= 16	
kThemeResizeLeftRightCursor	= 17	

## Font Constants

kThemeSystemFont	= 0
kThemeSmallSystemFont	= 1
kThemeSmallEmphasizedSystemFont	= 2
kThemeViewsFont	= 3
kThemeEmphasizedSystemFont	= 4
kThemeApplicationFont	= 5
kThemeLabelFont	= 6
kThemeCurrentPortFont	= 200

## Data Types

```
typedef UInt32 ThemeDrawState;
typedef SInt16 ThemeBrush;
typedef SInt16 ThemeTextColor;
typedef UInt32 ThemeCursor;
typedef struct OpaqueThemeDrawingState* ThemeDrawingState;
```

## Functions

### Drawing Appearance Primitives

```
OSStatus DrawThemeWindowHeader(const Rect *inRect, ThemeDrawState inState);
OSStatus DrawThemeWindowListViewHeader(const Rect *inRect, ThemeDrawState inState);
OSStatus DrawThemePlacard(const Rect *inRect, ThemeDrawState inState);
OSStatus DrawThemeEditTextFrame(const Rect *inRect, ThemeDrawState inState);
OSStatus DrawThemeListBoxFrame(const Rect *inRect, ThemeDrawState inState);
OSStatus DrawThemeFocusRect(const Rect *inRect, Boolean inHasFocus);
OSStatus DrawThemePrimaryGroup(const Rect *inRect, ThemeDrawState inState);
OSStatus DrawThemeSecondaryGroup(const Rect *inRect, ThemeDrawState inState);
OSStatus DrawThemeSeparator(const Rect *inRect, ThemeDrawState inState);
OSStatus DrawThemeModelessDialogFrame(const Rect *inRect, ThemeDrawState inState);
OSStatus DrawThemeGenericWell(const Rect *inRect, ThemeDrawState inState,
    Boolean inFillCenter);
```

```
OSStatus DrawThemeFocusRegion(RgnHandle inRegion, Boolean inHasFocus);
OSStatus DrawThemeTab(const Rect *inRect, ThemeTabStyle inStyle, ThemeTabDirection inDirection,
    ThemeTabTitleDrawUPP labelProc, UInt32 userData);
OSStatus DrawThemeTabPage(const Rect *inRect, ThemeDrawState inState);
```

### Drawing in Colors/Patterns Consistent with Platinum/Aqua

```
OSStatus SetThemeWindowBackground(WindowPtr inWindow, ThemeBrush inBrush, Boolean inUpdate);
OSStatus SetThemeBackground(ThemeBrush inBrush, SInt16 inDepth, Boolean inIsColorDevice);
OSStatus SetThemePen(ThemeBrush inBrush, SInt16 inDepth, Boolean inIsColorDevice);
OSStatus SetThemeTextColor(ThemeTextColor inColor, SInt16 inDepth, Boolean inIsColorDevice);
```

### Setting and Getting the Graphics Port Font

```
OSStatus UseThemeFont(ThemeFontID inFontID, ScriptCode inScript);
OSStatus GetThemeFont(ThemeFontID inFontID, ScriptCode inScript, Str255 outFontName,
    SInt16 *outFontSize, Style *outStyle);
```

### Drawing Text

```
OSStatus DrawThemeTextBox(CFStringRef inString, ThemeFontID inFontID, ThemeDrawState inState,
    Boolean inWrapToWidth, const Rect *inBoundingBox, SInt16 inJust, void *inContext);
OSStatus TruncateThemeText(CFMutableStringRef inString, ThemeFontID inFontID,
    ThemeDrawState inState, SInt16 inPixelWidthLimit, TruncCode inTruncWhere,
    Boolean *outTruncated);
OSStatus GetThemeTextDimensions(CFStringRef inString, ThemeFontID inFontID,
    ThemeDrawState inState, Boolean inWrapToWidth, Point *ioBounds, SInt16 *outBaseline);
OSStatus GetThemeTextShadowOffset(ThemeFontID inFontID, ThemeDrawState inState,
    Rect * outOffset);
```

### Saving and Setting the Graphics Port Drawing State

```
OSStatus NormalizeThemeDrawingState(void);
OSStatus GetThemeDrawingState(ThemeDrawingState *outState);
OSStatus SetThemeDrawingState(ThemeDrawingState inState, Boolean inDisposeNow);
OSStatus DisposeThemeDrawingState(ThemeDrawingState inState);
```

### Setting Appearance Cursors

```
OSStatus SetThemeCursor(ThemeCursor inCursor);
OSStatus SetAnimatedThemeCursor(ThemeCursor inCursor, UInt32 inAnimationStep);
```

### Getting Menu Bar Height

```
OSStatus GetThemeMenuBarHeight(SInt16 *outHeight);
```

## Demonstration Program Appearance Listing

```
// *****
// Appearance.c CLASSIC EVENT MODEL
// *****
//
// This program opens two kWindowDocumentProc windows containing:
//
// · In the first window:
//
// · On Mac OS 8/9, a theme-compliant list view.
//
```

```

//      · On Mac OS X, some text drawn with Appearance Manager functions.
//
//      · In the second window, various images drawn with Appearance primitives and, on Mac OS
//      8/9, text drawn in the window header in the correct Appearance color.
//
// Two of the images in the second window are edit text field frames and one is a list box
// frame. At any one time, one of these will have a keyboard focus frame drawn around it.
// Clicking in one of the other frames will move the keyboard focus frame to that frame.
//
// The program utilises the following resources:
//
//      · A 'plst' resource.
//
//      · An 'MBAR' resource, and 'MENU' resources for Apple, File, and Edit menus (preload,
//      non-purgeable).
//
//      · Two 'WIND' resources (purgeable) (initially not visible).
//
//      · A 'STR#' list resource (purgeable) containing text drawn in the first window.
//
//      · 'hrcr' and 'hwin' resources (both purgeable), which provide help balloons describing the
//      contents of the windows (Mac OS 8/9).
//
//      · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//      doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****
// ..... includes
#include <Carbon.h>

// ..... defines

#define rMenubar          128
#define rNewWindow1      128
#define rNewWindow2      129
#define mAppleApplication 128
#define iAbout           1
#define mFile             129
#define iQuit             12
#define sDescription      128
#define MAX_UINT32        0xFFFFFFFF

// ..... global variables

Boolean  gRunningOnX = false;
Boolean  gDone;
Boolean  gInBackground;
WindowRef gWindowRef1, gWindowRef2;
SInt16   gPixelDepth;
Boolean  gIsColorDevice = false;
Rect      gCurrentRect;
Rect      gEditText1Rect = { 141, 20, 162, 239 };
Rect      gEditText2Rect = { 169, 20, 190, 239 };
Rect      gListBoxRect   = { 203, 90, 300, 239 };

```



```
// ..... function prototypes

void main                                (void);
void doPreliminaries                    (void);
OSErr quitAppEventHandler               (AppleEvent *,AppleEvent *,SInt32);
void doEvents                           (EventRecord *);
void doUpdate                           (EventRecord *);
void doActivate                         (EventRecord *);
void doActivateWindow                   (WindowRef,Boolean);
void doOSEvent                          (EventRecord *);
void doDrawAppearancePrimitives         (ThemeDrawState);
void doDrawThemeCompliantTextOn9        (WindowRef,ThemeDrawState);
void doDrawListViewOn9                  (WindowRef);
void doDrawThemeTextOnX                  (WindowRef,ThemeDrawState);
void doChangeKeyboardFocus              (Point);
void doGetDepthAndDevice                (void);

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;
    MenuRef        menuRef;
    SInt16         fontNum;
    EventRecord     EventStructure;

    // ..... do preliminaries

    doPreliminaries();

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMenubar);
    if(menubarHdl == NULL)
        ExitToShell();
    SetMenuBar(menubarHdl);
    DrawMenuBar();

    Gestalt(gestaltMenuMgrAttr,&response);
    if(response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
        {
            DeleteMenuItem(menuRef,iQuit);
            DeleteMenuItem(menuRef,iQuit - 1);
            DisableMenuItem(menuRef,0);
        }

        gRunningOnX = true;
    }
}
```

```

// ..... open first window, set font and font size, show window

if(!(gWindowRef1 = GetNewCWindow(rNewWindow1,NULL,(WindowRef)-1)))
    ExitToShell();

SetPortWindowPort(gWindowRef1);
if(!gRunningOnX)
    UseThemeFont(kThemeSmallSystemFont,smSystemScript);
else
{
    GetFNum("\pAmerican Typewriter",&fontNum);
    TextFont(fontNum);
    TextSize(11);
}

if(!gRunningOnX)
    SetWTitle(gWindowRef1,"\pList Views");
else
    SetWTitle(gWindowRef1,"\pTheme Text");

ShowWindow(gWindowRef1);

// ..... open second window, set font, set background color/pattern, show window

if(!(gWindowRef2 = GetNewCWindow(rNewWindow2,NULL,(WindowRef)-1)))
    ExitToShell();

SetPortWindowPort(gWindowRef2);
UseThemeFont(kThemeSmallSystemFont,smSystemScript);

SetThemeWindowBackground(gWindowRef2,kThemeBrushDialogBackgroundActive,false);

ShowWindow(gWindowRef2);

// ..... get pixel depth and whether color device for certain Appearance Manager functions

if(!gRunningOnX)
    doGetDepthAndDevice();

// ..... set top edit text field rectangle as target for initial keyboard focus frame

gCurrentRect = gEditText1Rect;

// ..... enter eventLoop

gDone = false;

while(!gDone)
{
    if(WaitNextEvent(everyEvent,&EventStructure,MAX_UINT32,NULL))
        doEvents(&EventStructure);
}
}

```

```
// ***** doPreliminaries

void doPreliminaries(void)
{
    OSErr osError;

    MoreMasterPointers(32);
    InitCursor();
    FlushEvents(everyEvent,0);

    osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
                                   NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
                                   0L,false);

    if(osError != noErr)
        ExitToShell();
}

// ***** doQuitAppEvent

OSErr quitAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,SInt32 handlerRefcon)
{
    OSErr osError;
    DescType returnedType;
    Size actualSize;

    osError = AEGetAttributePtr(appEvent,keyMissedKeywordAttr,typeWildCard,&returnedType,NULL,0,
                                &actualSize);

    if(osError == errAEDescNotFound)
    {
        gDone = true;
        osError = noErr;
    }
    else if(osError == noErr)
        osError = errAEParamMissed;

    return osError;
}

// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    SInt32 menuChoice;
    MenuID menuID;
    MenuItemIndex menuItem;
    WindowPartCode partCode;
    WindowRef windowRef;

    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEProcessAppleEvent(eventStrucPtr);
            break;
    }
}
```

```

case keyDown:
    if((eventStrucPtr->modifiers & cmdKey) != 0)
    {
        menuChoice = MenuEvent(eventStrucPtr);
        menuID = HiWord(menuChoice);
        menuItem = LoWord(menuChoice);
        if(menuID == mFile && menuItem == iQuit)
            gDone = true;
    }
    break;

case mouseDown:
    if(partCode = FindWindow(eventStrucPtr->where,&windowRef))
    {
        switch(partCode)
        {
            case inMenuBar:
                menuChoice = MenuSelect(eventStrucPtr->where);
                menuID = HiWord(menuChoice);
                menuItem = LoWord(menuChoice);

                if(menuID == 0)
                    return;

                switch(menuID)
                {
                    case mAppleApplication:
                        if(menuItem == iAbout)
                        {
                            SysBeep(10);
                            HiliteMenu(0);
                        }
                        break;

                    case mFile:
                        if(menuItem == iQuit)
                            gDone = true;
                        break;
                }
                break;

            case inContent:
                if(windowRef != FrontWindow())
                    SelectWindow(windowRef);
                else
                {
                    if(FrontWindow() == gWindowRef2)
                    {
                        SetPortWindowPort(gWindowRef2);
                        doChangeKeyBoardFocus(eventStrucPtr->where);
                    }
                }
                break;
        }
    }

```

```

        case inDrag:
            DragWindow(windowRef,eventStrucPtr->where,NULL);
            break;
    }
}
break;

case updateEvt:
    doUpdate(eventStrucPtr);
    break;

case activateEvt:
    doActivate(eventStrucPtr);
    break;

case osEvt:
    doOSEvent(eventStrucPtr);
    break;
}
}

// ***** doUpdate

void doUpdate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;

    windowRef = (WindowRef) eventStrucPtr->message;

    BeginUpdate(windowRef);

    SetPortWindowPort(windowRef);

    if(windowRef == gWindowRef2)
    {
        if(gWindowRef2 == FrontWindow() && !gInBackground)
        {
            doDrawAppearancePrimitives(kThemeStateActive);
            DrawThemeFocusRect(&gCurrentRect,true);
            if(!gRunningOnX)
                doDrawThemeCompliantTextOn9(windowRef,kThemeStateActive);
        }
        else
        {
            doDrawAppearancePrimitives(kThemeStateInactive);
            if(!gRunningOnX)
                doDrawThemeCompliantTextOn9(windowRef,kThemeStateInactive);
        }
    }
}

if(windowRef == gWindowRef1)
{
    if(!gRunningOnX)
        doDrawListViewOn9(windowRef);
}

```

```

    EndUpdate(windowRef);
}

// ***** doActivate

void doActivate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    Boolean    becomingActive;

    windowRef = (WindowRef) eventStrucPtr->message;
    becomingActive = ((eventStrucPtr->modifiers & activeFlag) == activeFlag);
    doActivateWindow(windowRef, becomingActive);
}

// ***** doActivateWindow

void doActivateWindow(WindowRef windowRef, Boolean becomingActive)
{
    if(windowRef == gWindowRef2)
    {
        SetPortWindowPort(gWindowRef2);
        doDrawAppearancePrimitives(becomingActive);
        DrawThemeFocusRect(&gCurrentRect, becomingActive);

        if(!gRunningOnX)
            doDrawThemeCompliantTextOn9(windowRef, becomingActive);
    }
    else if(windowRef == gWindowRef1 && gRunningOnX)
    {
        SetPortWindowPort(gWindowRef1);
        doDrawThemeTextOnX(windowRef, becomingActive);
    }
}

// ***** doOSEvent

void doOSEvent(EventRecord *eventStrucPtr)
{
    switch((eventStrucPtr->message >> 24) & 0x000000FF)
    {
        case suspendResumeMessage:
            if((eventStrucPtr->message & resumeFlag) == 1)
            {
                SetThemeCursor(kThemeArrowCursor);
                gInBackground = false;
            }
            else
                gInBackground = true;
            break;
    }
}

```



```
// ***** doDrawAppearancePrimitives

void doDrawAppearancePrimitives(ThemeDrawState inState)
{
    Rect theRect;

    if(gRunningOnX)
    {
        GetWindowPortBounds(gWindowRef2,&theRect);
        EraseRect(&theRect);
    }

    SetRect(&theRect,-1,-1,261,26);
    DrawThemeWindowHeader(&theRect,inState);

    SetRect(&theRect,20,46,119,115);
    DrawThemePrimaryGroup(&theRect,inState);

    SetRect(&theRect,140,46,239,115);
    DrawThemeSecondaryGroup(&theRect,inState);

    SetRect(&theRect,20,127,240,128);
    DrawThemeSeparator(&theRect,inState);

    DrawThemeEditTextFrame(&gEditText1Rect,inState);

    DrawThemeEditTextFrame(&gEditText2Rect,inState);

    SetRect(&theRect,20,203,62,245);
    DrawThemeGenericWell(&theRect,inState,false);

    SetRect(&theRect,20,258,62,300);
    DrawThemeGenericWell(&theRect,inState,true);

    SetRect(&theRect,75,202,76,302);
    DrawThemeSeparator(&theRect,inState);

    DrawThemeListBoxFrame(&gListBoxRect,inState);

    SetRect(&theRect,-1,321,261,337);
    DrawThemePlacard(&theRect,inState);
}

// ***** doDrawThemeCompliantTextOn9

void doDrawThemeCompliantTextOn9(WindowRef windowRef,ThemeDrawState inState)
{
    SInt16 windowWidth, stringWidth;
    Rect portRect;
    Str255 message = "\pBalloon help is available";

    if(inState == kThemeStateActive)
        SetThemeTextColor(kThemeTextColorWindowHeaderActive,gPixelDepth,gIsColorDevice);
    else
        SetThemeTextColor(kThemeTextColorWindowHeaderInactive,gPixelDepth,gIsColorDevice);
}
```

```

    GetWindowPortBounds(windowRef,&portRect);
    windowWidth = portRect.right - portRect.left;
    stringWidth = StringWidth(message);
    MoveTo((windowWidth / 2) - (stringWidth / 2), 17);
    DrawString(message);
}

// ***** doDrawListViewOn9

void doDrawListViewOn9(WindowRef windowRef)
{
    Rect    theRect;
    SInt16 a;

    GetWindowPortBounds(windowRef,&theRect);

    SetThemeBackground(kThemeBrushListViewBackground,gPixelDepth,gIsColorDevice);
    EraseRect(&theRect);

    theRect.left += 130;

    SetThemeBackground(kThemeBrushListViewSortColumnBackground,gPixelDepth,gIsColorDevice);
    EraseRect(&theRect);

    SetThemePen(kThemeBrushListViewSeparator,gPixelDepth,gIsColorDevice);

    GetWindowPortBounds(windowRef,&theRect);

    for(a=theRect.top;a<=theRect.bottom;a+=18)
    {
        MoveTo(theRect.left,a);
        LineTo(theRect.right - 1,a);
    }

    SetThemeTextColor(kThemeTextColorListView,gPixelDepth,gIsColorDevice);

    for(a=theRect.top;a<=theRect.bottom +18;a+=18)
    {
        MoveTo(theRect.left,a - 5);
        DrawString("\p    List View Background        List View Sort Column");
    }
}

// ***** doDrawThemeTextOnX

void doDrawThemeTextOnX(WindowRef windowRef,ThemeDrawState inState)
{
    Rect    portRect;
    Str255  theString;
    CFStringRef stringRef;

    GetWindowPortBounds(windowRef,&portRect);
    EraseRect(&portRect);

```

```

if(inState == kThemeStateActive)
    TextMode(srcOr);
else
    TextMode(grayishTextOr);

SetRect(&portRect,portRect.left,30,portRect.right,50);
DrawThemeTextBox(CFSTR("System Font"),kThemeSystemFont,inState,true,
    &portRect,teJustCenter,NULL);
SetRect(&portRect,portRect.left,60,portRect.right,80);
DrawThemeTextBox(CFSTR("Emphasized System Font"),kThemeEmphasizedSystemFont,inState,true,
    &portRect,teJustCenter,NULL);
SetRect(&portRect,portRect.left,90,portRect.right,105);
DrawThemeTextBox(CFSTR("Small System Font"),kThemeSmallSystemFont,inState,true,
    &portRect,teJustCenter,NULL);
SetRect(&portRect,portRect.left,120,portRect.right,135);
DrawThemeTextBox(CFSTR("Small Emphasized System Font"),kThemeSmallEmphasizedSystemFont,
    inState,true,&portRect,teJustCenter,NULL);
SetRect(&portRect,portRect.left,150,portRect.right,170);
DrawThemeTextBox(CFSTR("Application Font"),kThemeApplicationFont,inState,true,
    &portRect,teJustCenter,NULL);
SetRect(&portRect,portRect.left,180,portRect.right,190);
DrawThemeTextBox(CFSTR("Label Font"),kThemeLabelFont,inState,true,
    &portRect,teJustCenter,NULL);

GetIndString(theString,sDescription,1);
stringRef = CFStringCreateWithPascalString(NULL,theString,CFStringGetSystemEncoding());
SetRect(&portRect,portRect.left + 20,210,portRect.right - 20,300);
DrawThemeTextBox(stringRef,kThemeCurrentPortFont,inState,true,&portRect,teJustCenter,NULL);

if(stringRef != NULL)
    CFRelease(stringRef);
}

// ***** doChangeKeyBoardFocus

void doChangeKeyBoardFocus(Point mouseXY)
{
    Rect portRect;

    DrawThemeFocusRect(&gCurrentRect,false);
    DrawThemeEditTextFrame(&gCurrentRect,kThemeStateActive);
    SetPortWindowPort(gWindowRef2);
    GlobalToLocal(&mouseXY);

    if(PtInRect(mouseXY,&gEditText1Rect))
        gCurrentRect = gEditText1Rect;
    else if(PtInRect(mouseXY,&gEditText2Rect))
        gCurrentRect = gEditText2Rect;
    else if(PtInRect(mouseXY,&gListBoxRect))
        gCurrentRect = gListBoxRect;

    GetWindowPortBounds(gWindowRef2,&portRect);
    InvalWindowRect(gWindowRef2,&portRect);
}

```

```
// ***** doGetDepthAndDevice

void doGetDepthAndDevice(void)
{
    GDHandle deviceHdl;

    deviceHdl = GetMainDevice();
    gPixelDepth = (*(deviceHdl->gdPMap)->pixelSize;
    if(((1 << gdDevType) & (*deviceHdl->gdFlags) != 0)
        gIsColorDevice = true;
}

// *****
```

## Demonstration Program Appearance Comments

When this program is run, the user should

- With the “Drawing with Primitives” window frontmost, click in the edit text frame not currently outlined with the keyboard focus frame, or in the list box frame, so as to move the keyboard focus frame to that rectangle.
- Click on the desktop to send the application to the background and note the changed appearance of the frames and text in the “Drawing with Primitives” window. On Mac OS 8/9, note also that there is no change to the appearance of the content region of the “List Views” window. On Mac OS X, note the changed appearance of the text in the “Theme Text” window. Click on the “Drawing with Primitives” window to bring the application to the foreground with that window active, noting the changed appearance of the frames and text. Click on the “Theme Text” window to make it active and note the changed appearance of the text.
- On Mac OS 8/9, Choose Show Balloons from the Help menu and move the cursor over the frames in the window titled “Drawing with Primitives” window (when active), and the left and right sides of the window titled “List Views” (when active), noting the descriptions in the balloons.

In the following, reference is made to graphics devices and pixel depth. Graphics devices and pixel depth are explained in Chapter 11.

### Global Variables

gWindowRef1 and gWindowRef2 will be assigned references to window objects.

gPixelDepth will be assigned the pixel depth of the main device (screen). gIsColorDevice will be assigned true if the graphics device is a color device and false if it is a monochrome device. The values in these two variables are required by certain Appearance Manager functions.

`gCurrentRect` will be assigned the rectangle which is to be the current target for the keyboard focus frame. `gEditText1Rect`, `gEditText2Rect`, and `gListBoxRect` are assigned the rectangles for the two edit text frames and the list box frame.

## main

After each window is created, its graphics port is set as the current port before the port's font is set. For the first window's graphics port, if the program is running on Mac OS 8/9, the Appearance Manager function `UseThemeFont` is called to set the font to the small system font. Otherwise the Font Manager function `GetFNum` is called to get the font number for American Typewriter, which is then set as the port's font, at 11 points, by the QuickDraw functions `TextFont` and `TextSize`. For the second window's graphics port, `UseThemeFont` is called to set the font to the small system font.

If the program is running on OS 8/9, `SetThemeWindowBackground` is called to set a theme-compliant color/pattern for the "Drawing with Primitives" window's content area. This means that the content area will be automatically repainted with that color/pattern when required with no further assistance from the application. When false is passed in the third parameter, the content region of the window is not invalidated. (Passing true in this instance is not appropriate because the window is not yet showing.)

If the program is running on OS 8/9, `doGetDepthAndDevice` is called to determine the current pixel depth of the graphics port, and whether the current graphics device is a color device, and assign the results to the global variables `gPixelDepth` and `gIsColorDevice`. These values are required by certain Appearance Manager functions which, in this program, are not called if the program is running on Mac OS X.

The next line sets the initial target for the keyboard focus frame. This is the rectangle used by the first edit text field frame.

## doEvents

At the `mouseDown` case, the `inContent` case within the `partCode` switch is of relevance to the demonstration.

If the mouse-down was within the content region of a window, and if that window is not the front window, `SelectWindow` is called to bring that window to the front and activate it.

However, if the window is the front window, and if that window is the "Drawing with Primitives" window, that window's graphics port is set as the current graphics port for drawing, and `doChangeKeyboardFocus` is called. That function determines whether the mouse-down was within one of the edit text field frames or the list box frame, and moves the keyboard focus if necessary.

### **doUpdate**

Within the `doUpdate` function, if the window to which the update event relates is the “Drawing with Primitives” window, if that window is currently the front window, and if the application is not currently in the background:

- Functions are called to draw the primitives and, on Mac OS 8/9 only, the window header text in the active mode.
- `DrawThemeFocusRect` is called to draw the keyboard focus frame using the rectangle currently assigned to the global variable `gCurrentRect`.

If, however, the “Drawing with Primitives” window is not the front window, the same calls are made but with the primitives and, on Mac OS 8/9 only, text being drawn in the inactive mode. Note that no call is required to erase the keyboard focus frame because this will already have been erased when the window was deactivated.

If the window to which the update event relates is the “List Views” window, `doDrawListViewOn9` is called to draw the window’s content area. Note that, for this window, there is no differentiation between active and inactive modes. This is because, for list views, the same brush type constants are used regardless of whether the window is active or inactive.

### **doActivateWindow**

When an activate event is received for the “Drawing with Primitives” window, functions are called to draw the primitives and, on Mac OS 8/9 only, the window header text. In addition, an Appearance Manager function which draws and erases the keyboard focus rectangle is called. The value passed in the `becomingActive` parameter of these calls ensures ensure that, firstly, the primitives and text are drawn in the appropriate mode and, secondly, the keyboard focus frame is either drawn or erased, depending on whether the window is coming to the front or being sent to the back.

If the activate event is for the first window and the program is running on Mac OS X, `doDrawThemeTextOnX` is called to draw some text in the window in either the active or inactive mode.

### **doDrawAppearancePrimitives**

`doDrawAppearancePrimitives` uses Appearance Manager functions for drawing Appearance primitives, and is called to draw the various frames in the “Drawing with Primitives” window. The mode in which the primitives are drawn (active or inactive) is determined by the Boolean value passed in the `inState` parameter.

### **doDrawThemeCompliantTextOn9**

`doDrawThemeCompliantTextOn9`, which is called only if the program is running on Mac OS 8/9, draw some advisory text in the window header of the “Drawing with Primitives” window. The QuickDraw drawing function `DrawString` does the drawing; however, before the drawing begins, the Appearance Manager function `SetThemeTextColor` is used to set the foreground



color for drawing text, in either the active or inactive modes, so as to comply with the Platinum appearance.

At the first two lines, if “Drawing with Primitives” is the active window, `SetThemeTextColor` is called with the `kThemeTextColorWindowHeaderActive` text color constant passed in the first parameter. At the next two lines, if the window is inactive, `SetThemeTextColor` is called with `kThemeTextColorWindowHeaderInactive` passed in the first parameter. Note that `SetThemeTextColor` requires the pixel depth of the graphics port, and whether the graphics device is a color device or a monochrome device, passed in the second and third parameters.

The next four lines simply adjust `QuickDraw`’s pen location so that the text is drawn centered laterally in the window header frame. The call to `DrawString` draws the specified text.

### **doDrawListViewOn9**

`doDrawListViewOn9`, which is called only if the program is running on Mac OS 8/9, draws a list view background in the specified window.

The first line copies the window’s port rectangle to a local variable of type `Rect`.

The call to `SetThemeBackground` sets the background color/pattern to the color/pattern represented by the theme-compliant brush type constant `kThemeBrushListViewBackground`. The `QuickDraw` function `EraseRect` fills the whole of the port rectangle with this color/pattern.

The next line adjusts the `Rect` variable’s left field so that the rectangle now represents the right half of the port rectangle. The same drawing process is then repeated, but this time with `kThemeBrushListViewSortColumnBackground` passed in the first parameter of the `SetThemeBackground` call.

`SetThemePen` is then called with the color/pattern represented by the constant `kThemeBrushListViewSeparator` passed in the first parameter. The rectangle for drawing is then expanded to equate with the port rectangle before the following five lines draw one-pixel-wide horizontal lines, at 18-pixel intervals, from the top to the bottom of the port rectangle.

Finally, some text is drawn in the list view in the theme-compliant color for list views. `SetThemeTextColor` is called with the `kThemeTextColorListView` passed in, following which a for loop draws some text, at 18-pixel intervals, from the top to the bottom of the port rectangle.

### **doDrawThemeTextOnX**

`doDrawThemeTextOnX` is called only if the program is running on Mac OS X. It draws anti-aliased text in the first window.

`GetWindowPortBounds` is called to copy the port rectangle to a local variable of type `Rect`. `EraseRect` is then called to erase the port rectangle, a necessary precursor to drawing over existing anti-aliased text on Mac OS X using the Appearance Manager function `DrawThemeTextBox`.

As was done in the function `doDrawThemeCompliantTextOn9`, `SetThemeTextColor` could be used here to set the text color according to the value received in the `inState` formal parameter. However, in this instance the alternative of calling `TextMode` is used. The so-called transfer modes passed in the calls to `TextMode` are explained in Chapter 12. `srcOr` is the default transfer mode for text, and causes the color of the glyph (the visual representation of a character) to be determined by the graphics port's foreground color. The non-standard mode `grayishTextOr` is used to draw text in the deactivated state.

Before each call to `DrawThemeTextBox`, `SetRect` is called to adjust the top and bottom fields of the `Rect` variable `portRect`. This controls the vertical positioning of the text in the window, being passed in `DrawThemeTextBox`'s `inBoundingBox` parameter. `teJustCenter` is passed in `DrawThemeTextBox`'s `inJust` parameter to cause the text to be center-justified within the rectangle. The Appearance Manager constants passed in the `inFontID` parameter determine the size and style of the drawn text.

At the last block, a string is retrieved from a 'STR#' Resource. After being converted to a `CFString`, that string is drawn by `DrawThemeTextBox` in the bottom of the window. Note that `kThemeCurrentPort` passed in the `inFontID` parameter so as to cause the text to be drawn using the window's graphics port font, which was set in `main`.

### **doChangeKeyboardFocus**

`doChangeKeyboardFocus` is called when a mouse-down occurs in the content region of the "Drawing with Primitives" window.

At the first two lines, Appearance Manager functions are used to, firstly, erase the keyboard focus frame from the rectangle around which it is currently drawn and, secondly, redraw an edit text field frame around that rectangle.

The call to `GlobalToLocal` converts the coordinates of the mouse-down to the local coordinates required by the following calls to `PtInRect`. `PtInRect` returns true if the mouse-down is within the rectangle passed in the second parameter. If one of the calls to `PtInRect` returns true, that rectangle is made the current rectangle for keyboard focus by assigning it to the global variable `gCurrentRect`.

The call to `InvalWindowRect` ensures that the keyboard focus frame will be drawn by the call to `DrawThemeFocusRect` in the function `doUpdate`.

### **doGetDepthAndDevice**

`doGetDepthAndDevice` determines the pixel depth of the graphics port, and whether the graphics device is a color device or a monochrome device, and assigns the results to two global variables. This information is required by the Appearance Manager functions `SetThemeTextColor`, `SetThemeBackground`, and `SetThemePen`.

# Introduction to Controls

## CHAPTER

# 7

## IN THIS CHAPTER

- Introduction 248
- Standard Controls 248
- The Control Definition Function 255
- The Basic Controls, Primary Group Boxes, and User Panes 256
- Activating, Deactivating, Hiding, Showing, Enabling, and Disabling Controls 260
- Visual Feedback from the Basic Controls 262
- Embedding Controls 263
- Getting and Setting Control Data 265
- The Control Object 266
- Creating Controls 268
- Updating, Moving, and Removing Controls 279
- Handling Mouse Events in Controls 279
- Determining and Changing Control Settings 282
- Moving and Resizing Scroll Bars 283
- Scrolling Operations with Scroll Bars 283
- Small Versions of Controls 287
- Main Control Manager Constants 288
- Demonstration Program Controls1 Listing 294
- Demonstration Program Controls1 Comments 314
- Demonstration Program Controls2 Listing 323
- Demonstration Program Controls2 Comments 334

## Introduction

On Mac OS 8/9, prior to the introduction of Mac OS 8 and the Appearance Manager, the system software provided for only a limited range of **controls** (specifically, buttons, checkboxes, radio buttons, pop-up menus, and scroll bars) and the creation and handling of these desktop objects was relatively simple and straightforward. Mac OS 8 and the Appearance Manager, however, ushered in a very wide range of additional controls, extended the capabilities of the old controls, and provided a generally richer control environment. The result is that the subject of controls is now considerably more involved; accordingly, this chapter constitutes an introduction to controls only and addresses only the more basic controls. All but one or two of the remaining controls are addressed in Chapter 14. The list box control is addressed in Chapter 22.

You can use the Control Manager to create and manage controls. An alternative method is to use the Dialog Manager to more easily create and manage controls in dialogs and alerts. In this latter case, the Dialog Manager works with the Control Manager behind the scenes. The creation and handling of controls in dialogs and alerts will be addressed in Chapter 8 and in the demonstration program associated with Chapter 14. The creation and handling areas of this chapter are limited to the use of the Control Manager to create and handle controls in document or utility windows.

Every control you create must be associated with a particular window. All the controls for a window are stored in a **control list**, a handle to which is stored in the window's window object.

## Standard Controls

The term **standard controls** refers to controls whose control definition functions are provided by the system software. The term **custom controls** refers to controls that you provide yourself via a custom control definition function.

## Available Standard Controls

The complete range of available standard controls is as follows.

<i>Control</i>	<i>Description</i>	<i>Variants</i>
Push button	A control that appears on the screen as a rounded rectangle with a title centered inside. When the user clicks a push button, the application performs the action	With title only.  With color icon to left of title.

Control	Description	Variants
	described by the button’s title. Examples include completing operations defined by a dialog and acknowledging an error message in an alert.	With color icon to right of title.
Checkbox	A control that appears onscreen as a small square with an accompanying title. A checkbox displays one of three settings: on (indicated by a checkmark inside the box), off, or mixed (indicated by a dash inside the box).	Non-auto-toggling. Auto-toggling
Radio button	A control that appears onscreen as a small circle. A radio button displays one of three settings: on (indicated by a black dot inside the circle), off, or mixed (indicated by a dash inside the circle). A radio button is always a part of a group of related radio buttons in which only one button can be on at a time.	Non-auto-toggling. Auto-toggling
Scroll bar	A control with which the user can change the portion of a document displayed within a window. A scroll bar is a light gray rectangle with <b>scroll arrows</b> at each end. Windows can have a horizontal scroll bar, a vertical scroll bar, or both. A vertical scroll bar lies along the right side of a window. A horizontal scroll bar runs along the bottom of a window. Inside the scroll bar is a rectangle called the <b>scroll box</b> (Mac OS 8/9) or <b>scroller</b> (Mac OS X). The rest of the scroll bar is called the <b>gray area</b> (Mac OS 8/9) or <b>track</b> (Mac OS X). The user can move through a document by manipulating the parts of the scroll bar.	Without live feedback. With live feedback.

<i>Control</i>	<i>Description</i>	<i>Variants</i>
Pop-up menu button	A control that is used to display a menu elsewhere than in the menu bar.	Fixed width. Variable width. Add resource. Use window font.
Bevel button	A button containing a self-descriptive icon, picture, text, or any combination of the three, that performs an action when pressed.	With small bevel (Mac OS 8/9 only).  With normal bevel.   With large bevel (Mac OS 8/9 only).  The above with a pop-up menu either to the right or below. Without live feedback. With live feedback. With tick marks. With directional indicator. With non-directional indicator.
Slider	A control that displays a range of values, magnitudes, or positions. A horizontally- and vertically-mobile <b>indicator</b> is used to increase or decrease the value.	
Disclosure triangle	A triangular control governing how items are displayed in a list. The disclosure triangle can point right or left and down. When the disclosure triangle points to the right or left, one item is displayed in the list. When the arrow points downward, the original item and its subitems are displayed in the list.	Right-facing.  Left-facing.  Right-facing, auto-tracking.  Left-facing, auto-tracking.

<i>Control</i>	<i>Description</i>	<i>Variants</i>
Progress bar.	<p>A control indicating that a lengthy operation is occurring. Two types of progress bar can be used: an <b>indeterminate</b> progress bar reveals that an operation is occurring but does not indicate its duration; a <b>determinate</b> progress bar displays how much of the operation has been completed.</p> <p>Progress bars are also used as relevance bars on Mac OS 8/9.</p>	<p>(One variant only.)</p> <p>However, the progress bar can be made determinate or non-determinate via a call to SetControlData.)</p>
Little arrows	Up- and down-arrows accompanying a text box that contains a value, such as a date. Clicking the up arrow increases the value displayed. Clicking the down arrow decreases the value displayed.	(One variant only.)
Chasing arrows	A control that indicates through a simple animation that a background process is in progress.	(One variant only.)
Tab	A control that appears as a row of folder tabs on top of a pane. It allows multiple panes to appear in the same window.	<p>Large, north facing.</p> <p>Small, north facing.</p> <p>Large, south facing.</p> <p>Small, south facing.</p> <p>Large, east facing.</p> <p>Small, east facing.</p> <p>Large, west facing.</p> <p>Small, west facing.</p>
Separator line	A control that draws a vertical or horizontal line used to visually separate groups of controls.	(One variant only.)
Primary group box	A control that consists of a rectangular two-pixel-wide frame that may or may not contain a title. It is used to provide a well-defined area in a dialog into which text, pictures, icons or other controls can be embedded.	<p>With text title.</p> <p>With checkbox title.</p> <p>With pop-up menu button title.</p>



<i>Control</i>	<i>Description</i>	<i>Variants</i>
Secondary group box	A control that consists of a rectangular one-pixel-wide frame which may or may not contain a title. It is used to provide a well-defined area in a dialog into which text, pictures, icons or other controls can be embedded.	With text title. With checkbox title. With pop-up button title.
Image well	A control that is used to display non-text visual content surrounded by a rectangular frame.	(One variant only.)
Pop-up arrow	A control that simply draws the pop-up glyph.	Large, east-facing. Large, west-facing. Large, north-facing. Large, south-facing. Small, east -facing. Small, west -facing. Small, north -facing. Small, south -facing.
Placard	A rectangular control used to delineate an area in which information may be displayed.	(One variant only.)
Clock	A control that combines the features of little arrows and an edit text field into a control which displays a date and/or time.	Displays hours, minutes.  Displays hours, minutes, seconds.  Displays date, month, year.
User pane	A general purpose control which can be used as the <b>root control</b> for a window and as an <b>embedder control</b> in which other controls may be embedded. It can also be used to hook in callback functions for drawing, hit testing, and so on.	Displays month, year. (One variant only.)

<i>Control</i>	<i>Description</i>	<i>Variants</i>
Edit text	A control that appears as a rectangular box in which the user enters text to provide information to an application.	Normal For passwords. For inline input.
Static text	A control that displays static (unchangeable by the user) text labels in a window.	(One variant only.)
Picture	A control used to display pictures.	Tracking. Non-tracking.
Icon	A control used to display icons.	Tracking. Non-tracking. Icon suite, tracking. Icon suite, non-tracking. All icon types, tracking. All icon types, non-tracking.
Window header	A rectangular control that is positioned along the top of a window's content region and which is used to delineate an area in which information may be displayed.	Window header. Window list view header.
List box	A control that combines a rectangular frame, scroll bar(s), and a scrolling list.	Non-autosizing. Autosizing.
Radio Group	A control that implements a radio button group.	(One variant only.)
Scrolling text box	A control that implements a scrolling text box.	Non-auto-scrolling. Auto-scrolling.
Data Browser	A control that implements a user interface component for browsing (optionally) hierarchical data structures.  <b>Note:</b> This control is not addressed in this book.	
Disclosure button	A button used to hide or show specific content. Available on Mac OS X only.	(One variant only)

<i>Control</i>	<i>Description</i>	<i>Variants</i>
Edit Unicode text	Similar to the edit text controls, except that it handles Unicode text. Available on Mac OS X only.	(One variant only)
Relevance bar.	A control that indicates a level of relevance. Available on Mac OS X only.	(One variant only.)
Round button	Similar to a push button, except that it is round. Available on Mac OS X only.	Normal size. Large size.

## Definition of the Term “Controls”

On Mac OS 8/9, prior to the introduction of Mac OS 8 and the Appearance Manager, a control was defined as an “on-screen object which the user can manipulate to cause an immediate action or to change settings to modify a future action.” Given this previous definition, the question arises as to why such objects as, for example, separator lines and window headers are now implemented as controls. On the surface, it may appear that these objects are purely visual entities.

Part of the answer to that question has to do with the matter of Mac OS 8/9 theme-compliance introduced with the Appearance Manager. For example, using the provided separator line “control” to draw separator lines will ensure that those lines are drawn with the correct Platinum appearance (and, on Mac OS X, the correct Aqua “look”) in both the activated and deactivated modes.

Another part of the answer has to do with the concept of **embedding**. The window header control, for example, is not just the visual entity it might at first appear to be; it is actually a control in which other controls may be embedded. (As will be seen, the ability to embed other controls is a powerful feature of some of the controls introduced with Mac OS 8 and the Appearance Manager.)

Since many of the new controls are not really controls “which the user can manipulate”, a more accurate blanket definition might now be “any element of the user interface that is implemented by a control definition function.”

## Controls Addressed in This Chapter

Of the controls listed above, only those that might be termed the **basic controls** (push buttons, checkboxes, radio buttons, scroll bars, and pop-up menu buttons), together with **primary group boxes** (text title variant) and **user panes**, will be addressed in this chapter and its associated demonstration programs. These controls, with the exception of the user pane (which is invisible), are illustrated in Figs 1 and 2.

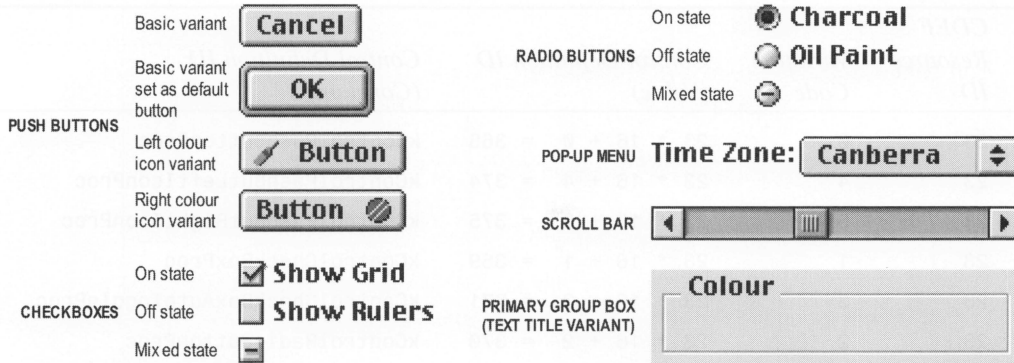


FIG 1 - THE BASIC CONTROLS AND THE PRIMARY GROUP BOX (TEXT TITLE VARIANT) (MAC OS 8/9)

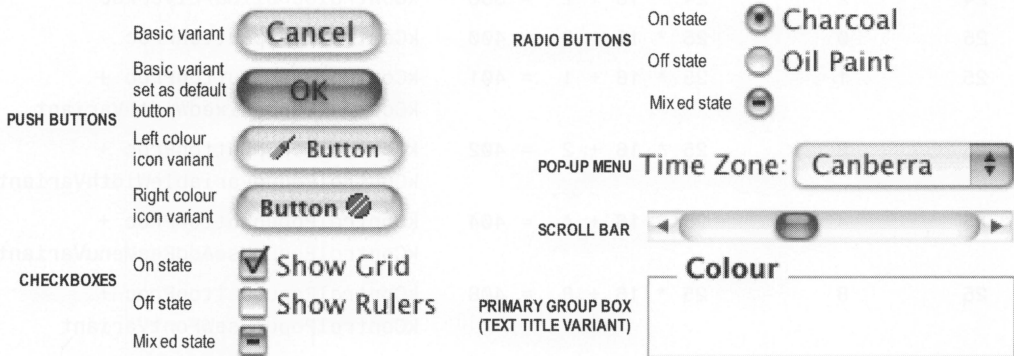


FIG 2 - THE BASIC CONTROLS AND THE PRIMARY GROUP BOX (TEXT TITLE VARIANT) (MAC OS X)

## The Control Definition Function

**Control definition functions** (CDEFs), which are stored as resources of type 'CDEF', determine the appearance and behavior of a control.

Just as a window definition function can describe variations of the same basic window, a CDEF can use a **variation code** to describe variations of the same control. You specify a particular control with a **control definition ID**, which is an integer containing the resource ID of the in the upper 12 bits and the variation code in the lower four bits.

The control definition ID is arrived at by multiplying the resource ID by 16 and adding the variation code. The following shows the control definition IDs for the standard controls and variants addressed in this chapter and its associated demonstration programs, together with the derivation of those IDs.

<i>CDEF Resource ID</i>	<i>Variation Code</i>	<i>Control Definition ID (Value)</i>	<i>Control Definition ID (Constant)</i>
23	0	$23 * 16 + 0 = 368$	kControlPushButtonProc
23	4	$23 * 16 + 4 = 374$	kControlPushButLeftIconProc
23	5	$23 * 16 + 5 = 375$	kControlPushButRightIconProc
23	1	$23 * 16 + 1 = 369$	kControlCheckBoxProc
23	3	$23 * 16 + 3 = 371$	kControlCheckBoxAutoToggleProc
23	2	$23 * 16 + 2 = 370$	kControlRadioButtonProc
23	4	$23 * 16 + 4 = 372$	kControlRadioAutoToggleButtonProc
24	0	$24 * 16 + 0 = 384$	kControlScrollBarProc
24	2	$24 * 16 + 2 = 386$	kControlScrollBarLiveProc
25	0	$25 * 16 + 0 = 400$	kControlPopupButtonProc
25	1	$25 * 16 + 1 = 401$	kControlPopupButtonProc + kControlPopupFixedWidthVariant
25	2	$25 * 16 + 2 = 402$	kControlPopupButtonProc + kControlPopupVariableWidthVariant
25	4	$25 * 16 + 4 = 404$	kControlPopupButtonProc + kControlPopupUseAddResMenuVariant
25	8	$25 * 16 + 8 = 408$	kControlPopupButtonProc + kControlPopupUseWFontVariant
10	0	$10 * 16 + 0 = 160$	kControlGroupBoxTextTitleProc
16	0	$16 * 16 + 0 = 256$	kControlUserPaneProc

Note that the a single CDEF caters for both horizontal and vertical scroll bars. The CDEF determines whether a scroll bar is vertical or horizontal from the rectangle you specify when you create the control.

## The Basic Controls, Primary Group Boxes (Text Title Variant), and User Panes

### Push Buttons

You normally use push buttons in alerts and dialogs.

In windows and dialogs containing push buttons, you should designate one push button as the **default push button**, that is, the push button the user is most likely to click. On Mac OS 8/9, the default push button is outlined. On Mac OS X it is colored and pulsing (see Fig 1).

In your application, pressing the Enter and Return keys should result in the same action as clicking on the default push button.

## Checkboxes

Checkboxes are typically used in dialogs. Checkboxes provide alternative choices and act like toggle switches. Each checkbox must have a title, which should reflect two clearly opposite states.

### Non-Auto-Toggling Variant

When the non-auto-toggling variant is being used, and when the user clicks a checkbox in the **off state**, your application should call `SetControlValue` to set the control to the **on state** and place a checkmark in the box (see Fig 1). When the user again clicks the checkbox, your application should call `SetControlValue` to set the control to the off state and remove the checkmark from the box.

`SetControlValue` may also be used to place a dash in the box to indicate that the control is in the **mixed state** (see Fig 1). The mixed state is a special state that indicates that a selected range of items has some in the on state and some in the off state. For example, a text formatting checkbox for bold text would be in the mixed state if a text selection contained both bold and non-bold text.

### Auto-Toggling Variant

When the auto-toggling variant is being used, checkboxes automatically change between their various states (on, off, and mixed) in response to user actions. Your application need only call the function `GetControl32BitValue` to get the checkbox's new state. There is no need to programmatically change the control's value after tracking successfully.

## Radio Buttons

Like checkboxes, radio buttons are typically used in dialogs. Unlike checkboxes, radio buttons within a group are mutually exclusive.

Radio buttons are typically grouped. Each group must have a label indicating the kind of choices offered by the group, and each button must have a title indicating what it does.

### Non-Auto-Toggling Variant

When the non-auto-toggling variant is being used, and when the user clicks a radio button in the off state, your application should call `SetControlValue` to

- Set that control to the **on state** and place a black dot in its circle (see Fig 1)
- Set the previously “on” button in the group to the **off state** and remove the black dot from its circle

`SetControlValue` may also be used to place a dash in the circle to indicate that the control is in the **mixed state** (see Fig 1). The mixed state is a special state that shows that a selected range has a variety of items in the on state. For example, a set of radio buttons for selecting font size might have buttons representing 10- and 12-point sizes. If a passage of text with both 10- and 12-point text was selected, both the 10 and 12 buttons would appear in the mixed state.

## Auto-Toggling Variant

When the auto-toggling variant introduced with Mac OS 8.5 is being used, radio buttons automatically change between their various states (on, off, and mixed) in response to user actions. Your application need only call the function `GetControl32BitValue` to get the radio button's new state. There is no need to programmatically change the control's value after tracking successfully.

## Scroll Bars

Scroll bars scroll a document within a window. Scroll bars have **scroll arrows** at each end and a movable **scroll box** (Mac OS 8/9) or **scroller** (Mac OS X). The part of a scroll bar not occupied by the scroll arrows and scroll box/scroller is called the **gray area** (Mac OS 8/9) or **track** (Mac OS X). When the user clicks in a scroll arrow or gray area/track, or drags the scroll box/scroller, your application must scroll the document as appropriate.

As previously stated, the CDEF for scroll bars supports two variants. The only difference between the two variants is that one supports **live feedback** and the other does not. In the case of scroll bars, live feedback (a generic term) may be used to perform **live scrolling** of a document in a window. Live scrolling means that, when the user attempts to drag the scroll box/scroller, the scroll box/scroller moves and the document scrolls as the user moves the mouse. (Without live scrolling, only a ghosted image of the scroll box/scroller moves. In addition, the document is only scrolled, and the scroll box/scroller proper is only redrawn at its new location, when the user releases the mouse button.)

## Scroll Arrows and Gray Area/Track

When the scroll arrows are clicked, your application should move the scroll box/scroller the appropriate distance in the direction of the arrow being clicked and scroll the window contents accordingly. Each click should move the window contents one unit in the specified direction. (In a text document, one unit would typically be one line of text.)

When the gray area/track is clicked above the scroll box/scroller, your application should move the document down so that the top unit of the previous view is at the bottom of the new view, and it should move the scroll box/scroller accordingly. A similar, but upward movement, should occur when the user clicks in the gray area/track below the scroll box/scroller.



## Scroll Box/Scroller

### Live Feedback Variant Not Used

When the live feedback variant is not being used, and when the user drags the scroll box/scroller, the Control Manager redraws the scroll box/scroller proper in its new position, and sets the control's value accordingly, when the user releases the mouse button. You must then ascertain the position (that is, the **value**) of the scroll box/scroller and, using this value, display the appropriate portion of the document.

### Live Feedback Variant Used

When the live feedback variant is being used, and when the user drags the scroll box/scroller, the Control Manager continually redraws the scroll box/scroller, and continually returns the control's position (that is, its **value**) as the scroll box/scroller moves. Once again, your application uses this value to display the appropriate portion of the document.

## Proportional Scroll Boxes/Scrollers

A proportional scroll box/scroller is one whose height (vertical scroll bars) or width (horizontal scroll bars) varies in relation to the height/width of the scroll bar so as to visually represent the proportion of the document visible in the window.

Those of your application's scroll boxes/scrollers created from 'CNTL' resources will appear as proportional scroll boxes/scrollers provided that you pass the size of the view area, in whatever units the scroll bar uses, to the function `SetControlViewSize`. The system automatically handles resizing the scroll box/scroller once your application supplies this information. (On Mac OS 8/9, the user must also have selected Smart Scrolling on in the Options tab in the Appearance control panel.) For scroll bars created programmatically using the function `CreateScrollBarControl`, you pass the size of the view area in the `viewSize` parameter.

The following functions are relevant to proportional scroll boxes/scrollers:

<i>Function</i>	<i>Description</i>
<code>GetControlViewSize</code>	Obtains the size of the content to which a control's size is proportioned
<code>SetControlViewSize</code>	Informs the Control Manager of the size of the content to which a control's size is proportioned

## Pop-Up Menu Buttons

Pop-up menu buttons provide an alternative method of providing the user with a list of choices. The items in a pop-up menu button's menu should be mutually exclusive. Pop-up menus should be used to provide a choice of attributes, and should not be used to provide additional commands.

## Primary Group Boxes (Text Title Variant)

A primary group box (text title variant) is a control that consists of a rectangular frame which may or may not contain a **title**. Group boxes are used to associate, isolate, and distinguish groups of related controls, such as a group of radio buttons.

The primary group box is an **embedder** control, meaning that you can embed other controls, such as radio buttons, checkboxes, and pop-up menu buttons, within it.

## User Panes

The user pane is unique among the family of controls in that it has no visual representation. It has two main uses:

- Like the primary group box, it can be used as an embedder control—that is, other controls may be embedded within it.
- It provides a way to hook in application-defined (callback) functions, known as user pane functions, which perform actions such as drawing, hit testing, and so on.

## Activating, Deactivating, Hiding, Showing, Enabling, and Disabling Controls

### Activating and Deactivating Controls

A control can be either **active** or **inactive**. A control should be made inactive when it is inappropriate for your application to respond to a mouse-down event in that control. The Control Manager displays inactive controls in a dimmed state. The Control Manager displays inactive basic controls and inactive primary group boxes as shown in Figs 3 and 4.

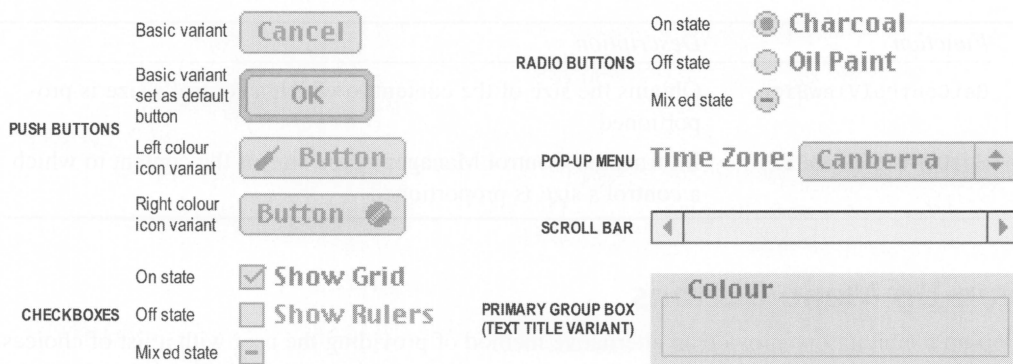


FIG 3 - THE BASIC CONTROLS AND THE PRIMARY GROUP BOX (TEXT TITLE VARIANT) IN INACTIVE MODE (MAC OS 8/9)

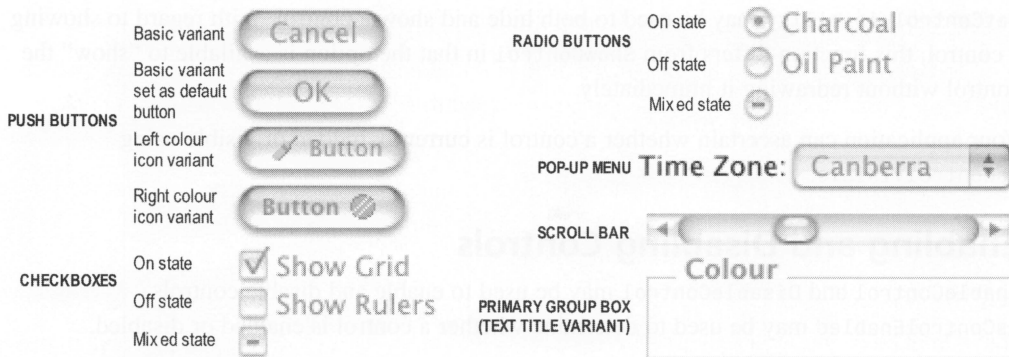


FIG 4 - THE BASIC CONTROLS AND THE PRIMARY GROUP BOX (TEXT TITLE VARIANT) IN INACTIVE MODE (MAC OS X)

## Activating and Deactivating Controls Other Than Scroll Bars

You use `ActivateControl` and `DeactivateControl` to make push buttons, checkboxes, radio buttons, pop-up menu buttons and primary group boxes active and inactive. You should make these controls inactive when

- They are not relevant to the current context. (But see also “Enabling and Disabling Controls.”)
- The window in which they reside is not the active window.

Your application can ascertain whether a control is currently active or inactive using `IsControlActive`.

## Activating and Deactivating Scroll Bars

Scroll bars become irrelevant to the current context when the document being displayed is smaller than the window in which it is being displayed. To make a scroll bar inactive in this case, you typically use `SetControlMaximum` to make the scroll bar’s maximum value equal to its minimum value, which causes the Control Manager to automatically make the scroll bar inactive and display it in the inactive state. To make the scroll bar active again, `SetControlMaximum` should be used to set its maximum value larger than its minimum value.

## Hiding and Showing Controls

`HideControl` may be used to hide a control. `HideControl` erases a control by filling its enclosing rectangle with the owning window’s background pattern.

`ShowControl` may be used to show a control. `ShowControl` makes the control visible and immediately draws the control within its window without using your window’s standard updating mechanism.

`SetControlVisibility` may be used to both hide and show a control. With regard to showing a control, this function differs from `ShowControl` in that the option is available to “show” the control without redrawing it immediately.

Your application can ascertain whether a control is currently hidden or visible using `IsControlVisible`.

## Enabling and Disabling Controls

`EnableControl` and `DisableControl` may be used to enable and disable controls. `IsControlEnabled` may be used to determine whether a control is enabled or disabled.

A distinction needs to be made between a disabled control and a deactivated control. A deactivated control is simply a control in a deactivated window. (All controls in a window should be deactivated when the window is deactivated.) A disabled control, on the other hand, is a control which the user should not currently be able to manipulate. The activation state of the window is immaterial in this case.

A “delete” button, for example, should be disabled when nothing is currently selected. As another example, controls in floating windows should never be deactivated, simply because floating windows themselves should never be deactivated. However, a control in a floating window should be disabled if the user should not currently be able to manipulate it.

It follows that a control in a deactivated window must be deactivated and may be either disabled or enabled.

A problem here is that, as of the time of writing, `EnableControl`, `DisableControl`, and `IsControlEnabled` are only available on Mac OS X. Thus, on Mac OS 8/9, the only way to deny user access to a control in an active window is to deactivate it.

## Visual Feedback from the Basic Controls

In response to a mouse-down event in a basic control, your application should call either `TrackControl` or `HandleControlClick`. These functions provide visual feedback when a mouse-down occurs in an active control by

- Displaying push buttons, checkboxes and radio buttons in their pressed mode
- Displaying and highlighting the items in pop-up menu buttons
- Highlighting the scroll arrows in scroll bars
- Moving the scroll box/scroller (live feedback variant of the scroll bar CDEF being used) or moving a ghosted image of the scroll box/scroller (live feedback variant not being used) when the user drags it

`HandleControlClick` was introduced with Mac OS 8 and the Appearance Manager. It is identical to `TrackControl` except that it allows modifier keys to be passed in its third parameter. Some of the newer controls, such as edit text fields and list boxes, require the ability for modifier keys to be passed in. If you use `HandleControlClick` with controls for which modifier keys are irrelevant, simply pass 0 in the `inModifiers` parameter.

## Embedding Controls

As previously stated, controls (or, more usually, a group of controls) may be embedded in **embedder controls**.

### The Root Control

The embedding of controls in a window requires that the window have a **root control**. The root control, which is implemented as a user pane control, is the **container** for all other window controls and is at the base of what is known as the **embedding hierarchy**.

On Mac OS X, a root control is created automatically in all document windows that have at least one other control. On Mac OS 8/9, however, you must explicitly create the root control in document windows by calling `CreateRootControl`. The root control may be retrieved by calling `GetRootControl`.

Once you have created a root control, new controls will be automatically embedded in the root control when they are created. One advantage of such embedding is that, when you wish to activate and deactivate all of the window's controls on window activation and deactivation, you can do so by simply activating and deactivating the root control. (If the root control did not exist, you would have to activate and deactivate all of the window's controls individually.) You can also hide and show all of the window's control by simply hiding and showing the root control.

### Other Embedders

Certain other controls also have embedding capability. One such embedder control is the primary group box. This means that you can embed, say, a group of radio buttons in a primary group box (which would, in turn, be already automatically embedded in the root control), an arrangement which is illustrated conceptually in Fig 5. By acting on the group box alone, you can then activate, deactivate, hide, show, and move all four controls as a group.

`EmbedControl` may be used to embed a control in another (embedder) control. However, where the control to be embedded is visually contained by the embedder, as is the case with the radio buttons in Fig 5, `AutoEmbedControl` would be more appropriate.

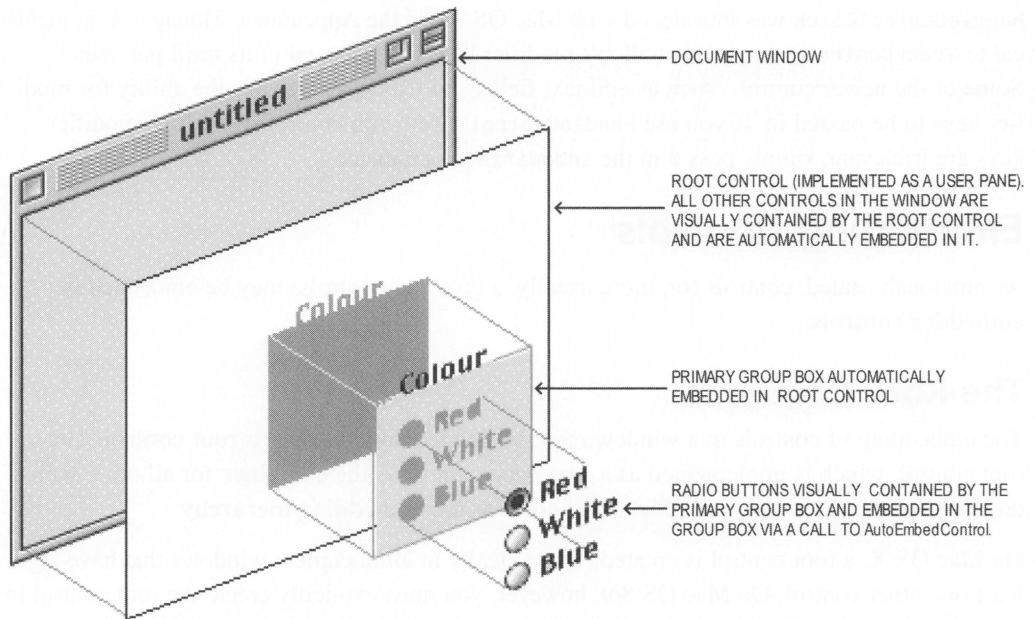


FIG 5 - THE ROOT CONTROL AND EMBEDDED CONTROLS

## Other Advantages of Embedding

### Drawing Order

As controls are created by your application, they are added to the head of the window's control list. When those controls are drawn in the absence of an embedding hierarchy, the Control Manager starts from the top of the control list, drawing the controls in the opposite order to the order in which it they were created.

In the example in Fig 5, assume that there is no embedding hierarchy and that the radio buttons are created after the group box. This means that the group box will be drawn after the radio buttons, thus obscuring the radio buttons. An embedding hierarchy, however, enforces drawing order by drawing the embedding control before its embedded controls regardless of which is created first.

### Hit Testing

Hit-testing is the process of testing whether a control is under the cursor at the time of a mouse-down event, and of identifying that control. For situations where controls are visually contained by other controls, an embedding hierarchy enforces orderly hit-testing by forcing an "inside-out" hit test aimed at determining the most deeply nested control that is hit by the mouse.



## Latency

Latency pertains to the ability of the Control Manager to remember the activation and visibility status of an embedded control when its embedder is cycled between activated and deactivated, or between visible and hidden.

For example, assume that the radio button labeled White in Fig 5 has been separately deactivated by the application. When the primary group box is deactivated, the two remaining radio buttons will also be deactivated. When the primary group box is again activated, the Control Manager remembers that the radio button labeled white was previously deactivated, and ensures that it remains in that mode.

## Getting and Setting Control Data

Getting and setting control data is essentially a mechanism that allows the outside world to access a control's specialized data without exposing how that data is stored. It allows you to easily set and get control fonts, tell the push button CDEF to draw the default outline around a default push button, and many other useful things.

Each piece of information that a particular CDEF allows access to is referenced by a **tag**, which is a constant that is meaningful to the CDEF and which represents the data in question. Each tagged piece of data can be of any data type, such as a menu reference or a structure.

**Control data tag constants** are passed in the third parameter of the getter and setter functions `SetControlData` and `GetControlData`. The control data tag constants relevant to the basic controls are as follows:

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
<code>kControlPushButtonDefaultTag</code>	Causes a push button to be drawn with the appearance of the default push button, or returns whether the push button is drawn with the default push button appearance. Data type returned or set: Boolean
<code>kControlPushButtonCancelTag</code>	Gets or sets whether a push button plays the Cancel button theme sound instead of the normal push button theme sound. Data type returned or set: Boolean. Default is false.
<code>kControlPopupButtonMenuRefTag</code>	Gets or sets the menu reference for a pop-up menu. Data type returned or set: MenuRef
<code>kControlPopupButtonMenuIDTag</code>	Gets or sets the menu ID for a pop-up menu button. Data type returned or set: SInt16



<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
kControlPopupButtonExtraHeightTag	Gets or sets the amount of extra white space in a pop-up menu button. Data type returned or set: SInt16. Default is 0.
kControlGroupBoxTitleRectTag	Get the rectangle that contains the title of a group box (and any associated control, such as a checkbox). Data type returned or set: Rect
kControlScrollBarShowsArrowsTag	Mac OS X only. Specifies whether the scroll arrows are to be drawn or not. Data type set: Boolean

## The Control Object

The Control Manager stores information about individual controls in opaque data structures called **control objects**. The data type `ControlRef` is defined as a pointer to a control object:

```
typedef struct OpaqueControlRef* ControlRef;
```

## Accessor Functions

Accessor functions are provided to access the information in control objects. The accessor functions are as follows:

<i>Function</i>	<i>Description</i>
GetControlOwner	Gets a reference to the window in which the specified control is located.
SetControlOwner	Assigns the specified control to a specified window.
GetControlBounds	Sets the specified control's enclosing rectangle.
SetControlBounds	Gets the specified control's enclosing rectangle.
IsControlVisible	Determines if the specified control is currently hidden or showing.
SetControlVisibility	Shows or hides the specified control.
IsControlHilited	Determines if the specified control is currently highlighted.
HiliteControl	Changes active/inactive status of a control or highlights a specified part of a control.
GetControlHilite	Determines whether the specified control is currently highlighted.

<i>Function</i>	<i>Description</i>
GetControlValue	Gets the specified control's value (16 bit) as set by SetControlValue.
SetControlValue	Sets the specified control's value (16 bit).
GetControl32BitValue	Sets the specified control's value as set by SetControl32BitValue.
SetControl32BitValue	Gets the specified control's value.
GetControlMaximum	Gets the specified control's maximum value (16 bit) as set by SetControlMaximum.
SetControlMaximum	Sets the specified control's maximum value (16 bit).
GetControl32BitMaximum	Gets the specified control's maximum value as set by SetControl32BitMaximum.
SetControl32BitMaximum	Sets the specified control's maximum value.
GetControlMinimum	Gets the specified control's minimum value (16 bit) as set by SetControlMinimum.
SetControlMinimum	Sets the specified control's minimum value (16 bit).
GetControl32BitMinimum	Gets the specified control's minimum value as set by SetControl32BitMinimum.
SetControl32BitMinimum	Sets the specified control's minimum value.
GetControlDataHandle	Gets a handle to data specific to a particular control type.
SetControlDataHandle	Sets a handle to data specific to a particular control type.
GetControlAction	Gets the universal procedure pointer to the specified control's action function.
SetControlAction	Sets a universal procedure pointer to the specified control's action function.
GetControlReference	Gets the specified control's reference constant.
SetControlReference	Sets the specified control's reference constant.
GetControlTitle	Gets the specified control's title.
SetControlTitle	Set the specified control's title.
GetControlDefinition	Gets the specified control's definition function.
GetControlPopupMenuHandle	Gets the specified popup menu button control's menu reference.
SetControlPopupMenuHandle	Sets the menu reference for a popup menu button control.
GetControlPopupMenuID	Gets the specified pop-up menu button control's menu ID.
SetControlPopupMenuID	Sets the menu ID for a pop-up menu button control.

## Creating Controls

When you use the Dialog Manager to implement push buttons, radio buttons, checkboxes or pop-up menu buttons in alerts or dialogs, Dialog Manager functions automatically use Control Manager functions to create the controls for you.

For document and utility windows, you can create controls from 'CNTL' resources or you can create them programmatically.

### Creating Controls From 'CNTL' Resources

You create controls from 'CNTL' resources using `GetNewControl`. `GetNewControl`, which takes a 'CNTL' resource ID and a reference to the window object, creates a control object from the information in the resource, adds the control object to the control list for your window, and returns a reference to the control.

Before you can create a control using `GetNewControl`, you must, of course, first create the necessary 'CNTL' resource. When creating resources with Resorcerer, it is advisable that you refer to a diagram and description of the structure of the resource and relate that to the various items in the Resorcerer editing windows. Accordingly, the following describes the structure of the 'CNTL' resource.

### Structure of a Compiled 'CNTL' Resource

Fig 6 shows the structure of a compiled 'CNTL' resource and how it “feeds” the control object.

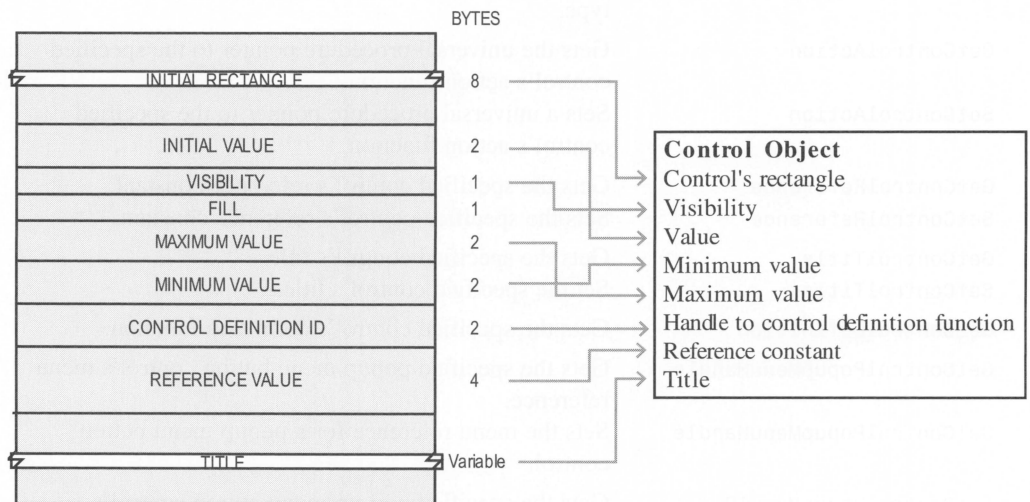


FIG 6 - STRUCTURE OF A COMPILED CONTROL ('CNTL') RESOURCE

The following describes the main fields of the 'CNTL' resource:

<i>Field</i>	<i>Description</i>
INITIAL RECTANGLE	A rectangle that determines the control's size and location. It is specified in local coordinates.
INITIAL VALUE	Initial value for the control. (See "Values for Controls.")
VISIBILITY	Visibility of the control. When this field contains the value <code>true</code> , <code>GetNewControl</code> draws the control immediately. When this field contains <code>false</code> , the application must use <code>ShowControl</code> when the time has come to display the control.
MAXIMUM VALUE	Maximum value of the control. (See "Values for Controls.")
MINIMUM VALUE	Minimum value for the control. (See "Values for Controls.")
CONTROL DEFINITION ID	The control definition ID. (See "The Control Definition Function.")
REFERENCE VALUE	The control's reference value, which is set up and used only by the application (except when the control is the add resource variant of the pop-up menu button, in which case this field is used to specify the resource type).
TITLE	For controls that need a title, the string for that title. For controls that do not need or do not use titles, an empty string.

### Values For Controls

The following lists the initial, minimum, and maximum value settings for the basic controls and the primary group box:

<i>Control</i>	<i>Initial Value</i>	<i>Minimum Value</i>	<i>Maximum Value</i>
Push button	0	0	1
Checkbox	0 (initially off), or 1 (initially on), or 2 (initially in mixed state).	0	1, or 2 if mixed state checkboxes are to be used.
Radio button	0 (initially off), or 1 (initially on), or 2 (initially in mixed state).	0	1, or 2 if mixed state radio buttons are to be used.

<i>Control</i>	<i>Initial Value</i>	<i>Minimum Value</i>	<i>Maximum Value</i>
Scroll bar	Whatever initial value is appropriate (between the minimum and maximum settings).	Whatever minimum value is appropriate. The value must be between -32768 and 32767.	Whatever maximum value is appropriate. The value must be between -32768 and 32767.  When the maximum setting is equal to the minimum setting, the CDEF makes the scroll bar inactive. When the maximum setting is greater than the minimum setting, the CDEF makes the scroll bar active.
Pop-up menu button	A combination of values which instructs the Control Manager	Resource ID of the 'MENU' resource.	Width (in pixels) of the title. (See Pop-up Menu Button
Title	how to draw the control's title. (See Pop-up Menu Button Title Style Constants, below.)		Width, below.)
Primary group box	Ignored if the group box is the text title variant.	Ignored if the group box is the text title variant.	Ignored if the group box is the text title variant.

Note that the title of each of the three value fields is somewhat of a misnomer in the case of the pop-up menu button. These fields are thus said to be “overloaded.”

## Creating 'CNTL' Resources Using Resorcerer

Fig 7 shows a 'CNTL' resource being created with Resorcerer.

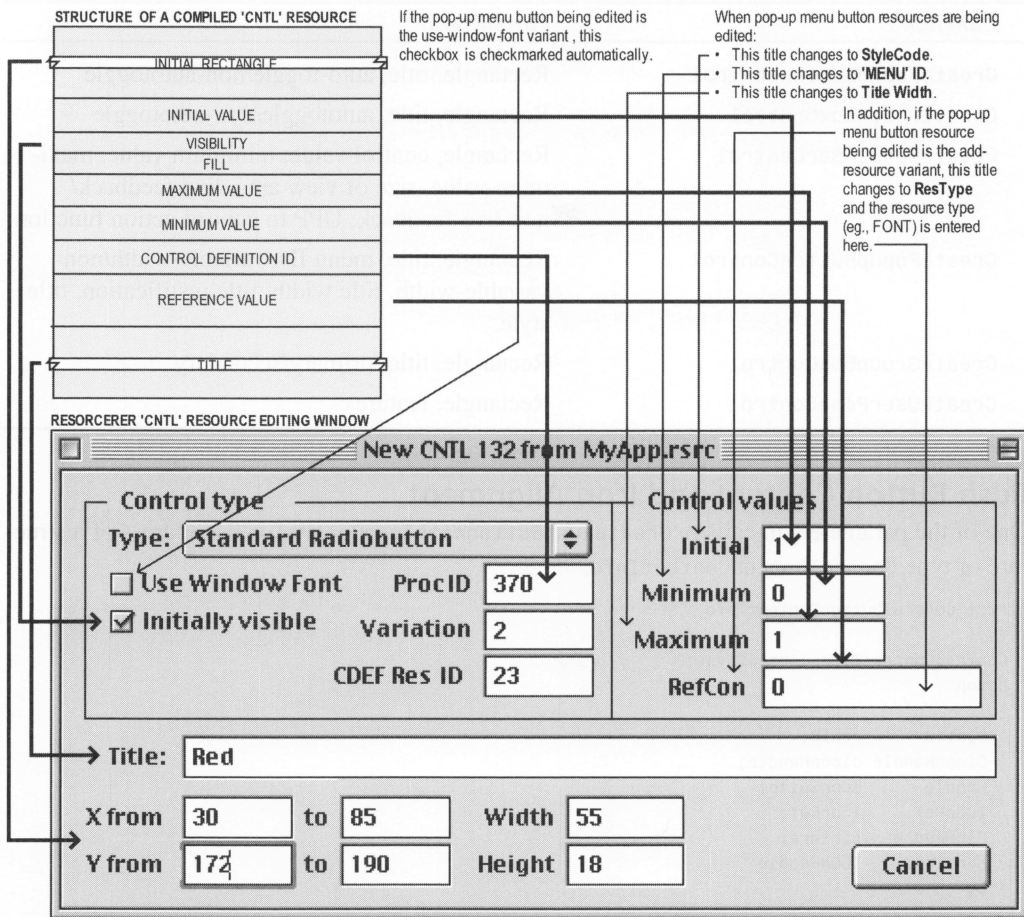


FIG 7 - CREATING A 'CNTL' RESOURCE USING RESORCER

## Creating Controls Programmatically

You can also create controls programmatically. The following functions, which were introduced with Carbon, may be used to programmatically create the controls described in this chapter:

Function	Parameters
CreatePushButtonControl	Rectangle, title
CreatePushButtonWithIconControl	Rectangle, title, address of ControlButtonContentInfo structure, icon alignment



<i>Function</i>	<i>Parameters</i>
CreateRadioButtonControl	Rectangle, title, auto-toggle/non-autotoggle
CreateCheckBoxControl	Rectangle, title, autotoggle/non-autotoggle
CreateScrollBarControl	Rectangle, control value, minimum value, maximum value, size of view area, live-feedback/non-live-feedback, UPP to control action function
CreatePopupButtonControl	Rectangle, title, menu ID, variable-width/non-variable-width, title width, title justification, title style.
CreateGroupBoxControl	Rectangle, title, primary/secondary
CreateUserPaneControl	Rectangle, features

## Push Button Content and Icon Alignment

One of the parameters in calls to `CreatePushButtonWithIconControl` is the address of a structure of type `ControlButtonContentInfo`:

```
struct ControlButtonContentInfo
{
    ControlContentType contentType;
    union
    {
        SInt16      resID;
        CIconHandle cIconHandle;
        Handle      iconSuite;
        IconRef     iconRef;
        PicHandle   picture;
        Handle      ICONHandle;
    } u;
};
typedef struct ControlButtonContentInfo ControlButtonContentInfo;
```

If, for example, you wish to specify a color icon for the button's icon content, you would assign `kControlContentCIconRes` to the `contentType` field and the icon's resource ID to the `resID` field.

Another parameter in calls to `CreatePushButtonWithIconControl` is a value of type `ControlPushButtonIconAlignment`. Relevant constants are

```
kControlPushButtonIconOnLeft
kControlPushButtonIconOnRight
```

## Additional Considerations—Scroll Bars

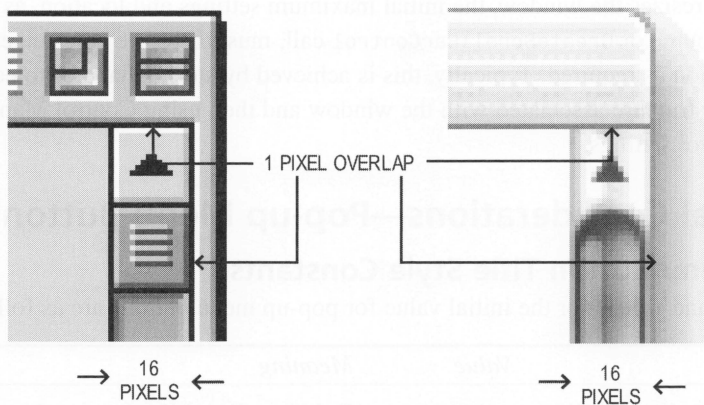
When creating scroll bars, you typically call `GetNewControl` or `CreateScrollBarControl` immediately after you create the window and then use `MoveControl`, `SizeControl`,



`SetControlMaximum` and `SetControlValue` to adjust the size, location and value settings. (For example, for a window displaying a text document, you would typically calculate the number of lines of text and set the vertical scroll bar's maximum value according to the line count and the window's current height. You would set the control's value according to the part of the document to be initially displayed.)

Most applications allow the user to change the size of windows, add information to the document and remove information from the document. It is therefore necessary, in your window handling code, to calculate a changing maximum setting based on the document's current size and its window's current size. For new documents which have no content to scroll, assign an initial value of 0 as the maximum setting (which will, as previously stated, make the scroll bars inactive). Thereafter, your window-handling code should set and maintain the maximum setting.

A scroll bar for a document window is, by convention, 16 pixels wide (vertical scroll bars) and 16 pixels high (horizontal scroll bars). The Control Manager draws one-pixel lines around the scroll bar, based on the rectangle enclosing the scroll bar. As shown in Fig 8, these outside lines should overlap the inside lines of the window frame.



**FIG 8 - CORRECT OVERLAP OF SCROLL BAR ON WINDOW FRAME**

The following calculations determine the rectangle for a vertical scroll bar for a document window:

#### NOTE

Do not include the title bar area in these calculations.

<i>Coordinate</i>	<i>Calculation</i>
Top	Combined height of any items above the scroll bar–1.
Left	Width of window–15.
Bottom	Height of window–14.
Right	Width of window + 1.

The following calculations determine the rectangle for a horizontal scroll bar for a document window.

<i>Coordinate</i>	<i>Calculation</i>
Top	Height of window–15.
Left	Combined width of any items to the left of the scroll bar–1.
Bottom	Height of window + 1.
Right	Width of window–14.

When the user resizes the window, the initial maximum settings and location, as specified in the 'CNTL' resource or `CreateScrollBarControl` call, must therefore be changed dynamically by the application as required. Typically, this is achieved by storing handles to each scroll bar in a document structure associated with the window and then using Control Manager functions to change control settings.

## Additional Considerations—Pop-up Menu Buttons

### Pop-up Menu Button Title Style Constants

The constants and values for the initial value for pop-up menu buttons are as follows:

<i>Constant</i>	<i>Value</i>	<i>Meaning</i>
<code>popupTitleBold</code>	<code>0x0100</code>	Boldface font style
<code>popupTitleItalic</code>	<code>0x0200</code>	Italic font style
<code>popupTitleUnderline</code>	<code>0x0400</code>	Underline font style
<code>popupTitleOutline</code>	<code>0x0800</code>	Outline font style
<code>popupTitleShadow</code>	<code>0x1000</code>	Shadow font style
<code>popupTitleCondense</code>	<code>0x2000</code>	Condensed text
<code>popupTitleExtend</code>	<code>0x4000</code>	Extended text

### Pop-up Menu Button Title Width

Fig 9 shows the relationship between the title width and the enclosing rectangle of a pop-up menu box.



FIG 9 - POP-UP MENU BUTTON TITLE WIDTH AND CONTROL RECTANGLE WIDTH

## Menu Width Adjustment

If the base variant or the variable width variant is being used, and whenever the pop-up menu button is redrawn, the CDEF calls `CalcMenuSize` to calculate the size of the menu associated with the control. If the sum of the width of the title, the longest item in the menu, the arrows, and a small amount of “white space” is less than the width of the control rectangle, the width of the pop-up button will be reduced for drawing purposes (see Fig 9). If the calculated width is greater than the width of the control rectangle, the longer menu items will be truncated with an added ellipsis so that the drawn pop-up will not exceed the width of the control rectangle.

## Menu Items and Control Values

When the control is created, the first menu item and the number of items in the pop-up menu button are stored in the control object. When the user chooses a different menu item, the Control Manager changes the item number value stored in the control object to that item number.

## Adding Resource Names As Items

If the add resource variant of the pop-up menu button is being used, the control reference constant value in the control object is coerced to type `ResType` and `AppendResMenu` is called to add items of that type. For example, if you specify `FONT` in the `ResType` item in the Resorcerer 'CNTL' resource editing window, the CDEF appends a list of fonts installed in the system to the menu specified at the 'MENU' ID item. In this situation, you can still store a reference constant in the control object by calling `SetControlReference` after the control has been created.

## Setting the Font of a Control's Title

You can set the font of any control's title independently of the system font or window font. To set the font of a control's title, you pass a pointer to a **control font style structure** in the `inStyle` parameter of the function `SetControlFontStyle`.

## Control Font Style Structure

```
struct ControlFontStyleRec
{
    SInt16  flags;
    SInt16  font;
```

```

SInt16  size;
SInt16  style;
SInt16  mode;
SInt16  just;
RGBColor foreColor;
RGBColor backColor;
};
typedef struct ControlFontStyleRec ControlFontStyleRec;
typedef ControlFontStyleRec *ControlFontStylePtr;

```

### Field Descriptions

**flags** Specifies which fields of the structure should be applied to the control (see “Control Font Style Flag Constants”). If no flags are set, the control uses the system font (or, for control variants which use the window font, the window font).

**font** Specifies the ID of the font family to use. Alternatively, a meta font constant may be assigned to this field (see “Meta Font Constants”).

**size** If the `kControlUseSizeMask` is set in the `flags` field, specifies the point size of the text. If the `kControlAddFontSizeMask` bit is set in the `flags` field, specifies the size to *add* to the current point size of the text. Alternatively, a meta font constant may be assigned to this field (see “Meta Font Constants”).

**style** Specifies the style to apply to the text. The bit numbers and the styles they represent are as follows:

<i>Bit Number</i>	<i>Style</i>
0	Bold
1	Italic
2	Underline
3	Outline
4	Shadow
5	Condensed
6	Extended

If all bits are clear, the plain font style is specified.

**mode** Specifies how characters are drawn in the bit image. (For a discussion of transfer modes, see Chapter 12.)

**just** Specifies text justification. The relevant constants are as follows:

<i>Constant</i>	<i>Value</i>
<code>teFlushDefault</code>	0
<code>teCenter</code>	1
<code>teFlushRight</code>	2
<code>teFlushLeft</code>	3

`foreColor` Specifies the RGB (red-green-blue) color to use when drawing the text.

`backColor` Specifies the RGB color to use when drawing the background behind the text. (Note that, in certain text modes, background color is ignored.)

## Control Font Style Flag Constants

You can pass one or more of the following control font style flag constants in the `flags` field of the control font style structure to specify those fields of the structure that are be applied to the control. If none of the flags of the `flags` field are set, the control uses the system font unless a control with a variant that uses the window font has been specified.

<i>Constant</i>	<i>Value</i>	<i>Meaning</i>
<code>kControlUseFontMask</code>	<code>0x0001</code>	The <code>font</code> field of the control font style structure is applied to the control.
<code>kControlUseFaceMask</code>	<code>0x0002</code>	The <code>style</code> field of the control font style structure is applied to the control. Ignored if you specify a meta font value (see “Meta Font Constants”).
<code>kControlUseSizeMask</code>	<code>0x0004</code>	The <code>size</code> field of the control font style structure is applied to the control. Ignored if you specify a meta font value (see “Meta Font Constants”).
<code>kControlUseForeColorMask</code>	<code>0x0008</code>	The <code>foreColor</code> field of the control font style structure is applied to the control. Applies only to static text controls.
<code>kControlUseBackColorMask</code>	<code>0x0010</code>	The <code>backColor</code> field of the control font style structure is applied to the control. Applies only to static text controls.
<code>kControlUseModeMask</code>	<code>0x0020</code>	The text mode specified in the <code>mode</code> field of the control font style structure is applied to the control.
<code>kControlUseJustMask</code>	<code>0x0040</code>	The <code>just</code> field of the control font style structure is applied to the control.

<i>Constant</i>	<i>Value</i>	<i>Meaning</i>
kControlUseAllMask	0x00FF	All flags in this mask will be set except kControlUseAddFontSizeMask.
kControlUseAddFontSizeMask	0x0100	The Dialog Manager will add a specified font size to the size field of the control font style structure.  Ignored if you specify a meta font value (see “Meta Font Constants”).

## Meta Font Constants

You can use the following meta font constants in the `font` field of the control font style structure to specify the style, size, and font family of a control’s font. You should use these meta font constants whenever possible because the system font can change, depending upon the current theme. If none of these constants are specified, the control uses the system font unless a control with a variant that uses the window font has been specified.

<i>Constant</i>	<i>Value</i>	<i>Meaning In Roman Script System</i>
kControlFontBigSystemFont	-1	Use the system font
kControlFontSmallSystemFont	-2	Use the small system font
kControlFontSmallBoldSystemFont	-3	Use the small emphasized system font
kControlFontViewSystemFont	-4	Use the views font

Another advantage of using these meta font constants is that you can be sure of getting the correct font on a Macintosh using a different script system, such as kanji.

## Setting and Getting Control IDs

The following functions, which were introduced with Carbon, may be used to set and get a control’s ID, and to get a reference to a control using the control’s ID:

<i>Function</i>	<i>Description</i>
SetControlID	Set a control’s ID
GetControlID	Get a control’s ID
GetControlByID	Get a reference to a control using the control’s ID



# Updating, Moving, and Removing Controls

## Updating Controls

When your application receives an update event for a window containing controls, it should call `UpdateControls` between the `BeginUpdate` and `EndUpdate` calls in its updating function.

Note that when you use the Dialog Manager to implement push buttons, radio buttons, checkboxes or pop-up menu buttons in alerts or dialogs, Dialog Manager functions automatically use Control Manager functions to update the controls for you.

## Moving Controls

You can change the position of a control using `MoveControl`, which erases the control, offsets the control's control rectangle, and redraws it at the specified new location

## Removing Controls

`DisposeControl` may be used to remove a control from a window, delete it from the window's control list, and release the control object and associated data structures from memory.

`KillControls` will dispose of all of a window's controls at once.

# Handling Mouse Events in Controls

## Overview

For mouse events in controls, you usually perform the following tasks:

- Use `FindWindow` to determine the window in which the mouse-down event occurred.
- If the mouse-down event occurred in the content region of the active window, use `FindControl` to determine whether the event occurred in a control and, if so, which control.
- Call `TrackControl` or `HandleControlClick` to handle user interaction with the control as long as the user holds the mouse button down. The `actionProc` parameter passed to `TrackControl`, or the `inAction` parameter passed to `HandleControlClick`, should be as follows:
  - `NULL` for push buttons, checkboxes and radio buttons.
  - For scroll arrows and gray areas/tracks of scroll bars, a universal procedure pointer which invokes an application-defined **action function** which, in turn, causes the document to scroll as long as the user holds the mouse button down.



- For the scroll box/scroller of scroll bars:
  - NULL if the non-live-feedback variant is being used.
  - If the live-feedback variant is being used, a pointer which invokes an application-defined action function which, in turn, causes the document to scroll while the scroll box/scroller is being dragged.
- (ControlActionUPP) -1 for pop-up menu buttons. This causes TrackControl and HandleControlClick to use the action function defined within the pop-up CDEF, a pointer to which is stored in the control object.

Note that, as an alternative to passing universal procedure pointers in the `actionProc` parameter of `TrackControl`, or the `inAction` parameter of `HandleControlClick`, you can preset the action function by passing the universal procedure pointer in the `actionProc` parameter of `SetControlAction`. (Ordinarily, you would call `SetControlAction` immediately after the control is created.) In this case, you must pass (ControlActionUPP) -1 in the `actionProc` and `inAction` parameters of `TrackControl` and `HandleControlClick`.

- When `TrackControl` or `HandleControlClick` reports that the user has released the mouse button with the cursor in a control, respond appropriately—that is
  - Perform the task identified by the push button title if the cursor is over a push button.
  - Toggle the value of the checkbox when the cursor is over a checkbox. (The Control Manager then redraws or removes the checkmark, as appropriate.)
  - Turn on the radio button, and turn off all other radio buttons in the group, when the cursor is over an active radio button.
  - Show more of the document in the direction of the scroll arrow when the cursor is over the scroll arrow or gray area/track of a scroll bar, and move the scroll box/scroller accordingly.
  - If the non-live-feedback scroll bar variant is being used, and when the cursor is over the scroll box/scroller, determine where the user has dragged the scroll box/scroller, and then display the corresponding portion of the document.
  - Use the new setting chosen by the user when the cursor is over a pop-up menu button.

## Determining a Mouse-Down Event in a Control

`FindControl` will return both a reference to the control as well as a **control part code** when a mouse-down event occurs in a visible, active control. `FindControl` will set the control reference to NULL and return 0 as the control part code when a mouse-down occurs in an invisible or inactive control, or when the cursor is not in a control.

A control part code is an integer from 1 to 255. Part codes are assigned to a control by its CDEF. The CDEFs for the basic controls define the following part codes:

<i>Constant</i>	<i>Value</i>	<i>Meaning</i>
<code>kControlNoPart</code>	0	Event did not occur in any control.  Also unhighlights any highlighted part of the control when passed to the <code>HiLiteControl</code> function.
<code>kControlLabelPart</code>	1	Event occurred in the label of a pop-up menu button.
<code>kControlMenuPart</code>	2	Event occurred in the menu of a pop-up menu button.
<code>kControlButtonPart</code>	10	Event occurred in a push button.
<code>kControlCheckBoxPart</code>	11	Event occurred in a checkbox.
<code>kControlRadioButtonPart</code>	12	Event occurred in a radio button.
<code>kControlUpButtonPart</code>	20	Event occurred in the up (or left) scroll arrow of a scroll bar.
<code>kControlDownButtonPart</code>	21	Event occurred in the down (or right) button of a scroll bar.
<code>kControlPageUpPart</code>	22	Event occurred in the page-up part of a scroll bar.
<code>kControlPageDownPart</code>	23	Event occurred in the page-down part of a scroll bar.
<code>kControlIndicatorPart</code>	129	Event occurred in the scroll box/scroller of a scroll bar.

A newer function (`FindControlUnderMouse`) will return a reference to the control even if no part was hit and can determine whether a mouse-down event has occurred even if the control is deactivated, whereas `FindControl` will not.

## Tracking the Cursor in a Control

When the call to `FindControl` determines that the cursor was in a control when the user pressed the mouse button, you should call `TrackControl` or `HandleControlClick` to follow and respond to the user's movements.

You can use an action function to perform additional actions while the user holds the mouse button down. Typically, action functions are used to continuously scroll the window's contents while the cursor is on a scroll arrow or gray area/track of a scroll bar, or in the scroll

box/scroller of a live-feedback scroll bar. (As previously stated, you pass a pointer to this action function in the `actionProc` parameter of `TrackControl` or the `inAction` parameter of `HandleControlClick`).

`TrackControl` and `HandleControlClick` return the control's control part code if the user releases the mouse button while the cursor is still inside the control part, or `kControlNoPart` (0) if the cursor is outside the control part when the button is released. Your application should then respond appropriately.

## Determining and Changing Control Settings, and Getting a Control's Kind

### Determining and Changing Control Settings

Your application often needs to determine the current setting and other values of a control when the user clicks the control. When the user clicks a non-auto-toggling checkbox, for example, your application must determine whether the box is currently checked before deciding whether to clear or draw the checkmark.

Your application can use the control value accessor functions described at The Control Object, above, to get and set a control's value, minimum value, and maximum value.

### Getting a Control's Kind

You can determine a control's kind using `GetControlKind`. The control's kind is returned in a structure of type `ControlKind`:

```
struct ControlKind
{
    OSType signature; // kControlKindSignatureApple ('appl') for all system controls
    OSType kind;
};
typedef struct ControlKind ControlKind;
```

For the controls addressed in this chapter, the following constants pertain to the kind field:

<i>Constant</i>	<i>Value</i>	<i>Control Kind</i>
<code>kControlKindPushButton</code>	'push'	Push button
<code>kControlKindPushIconButton</code>	'picn'	Push button (color icon variant)
<code>kControlKindCheckBox</code>	'cbox'	Checkbox
<code>kControlKindRadioButton</code>	'rdio'	Radio button
<code>kControlKindScrollBar</code>	'sbar'	Scroll bar
<code>kControlKindPopupButton</code>	'popb'	Pop-up menu button
<code>kControlKindGroupBox</code>	'grpb'	Primary group box (text title variant)
<code>kControlKindUserPane</code>	'upan'	User pane

An alternative method is to call `GetControlData` with `kControlKindTag` passed in the `inTagName` parameter and the address of a variable of type `ControlKind` passed in the `inBuffer` parameter.

A problem here is that, as of the time of writing, both `GetControlKind` and the alternative method were only available on Mac OS X.

## Moving and Resizing Scroll Bars

When the user resizes your windows, your application must resize and move that window's scroll bars. The steps involved are

- Resize the window.
- Make each scroll bar invisible using `HideControl`.
- Move the scroll bars to the appropriate edges of the window using `MoveControl`.
- Lengthen or shorten each scroll bar (as appropriate) using `SizeControl`.
- After recalculating the maximum settings, update the settings and redraw the scroll boxes/scrollers using `SetControlMaximum` and `SetControlValue`.
- Make each scroll bar visible at its new location using `ShowControl`.

Each of the functions involved require a reference to the relevant scroll bar control. When your application creates a window, it should store references for each scroll bar in a document structure associated with that window.

## Scrolling Operations With Scroll Bars

### Scrolling Basics

#### Relationship Between Document, Window, and Scroll Bar

The relationship between a document and a window, and their representation in a scroll bar, is shown in Fig 10.

#### Distance and Direction to Scroll

When the user scrolls a document using scroll bars, your application must first determine the distance and direction to scroll. The distance to scroll is as follows:

- When the user drags the scroll box/scroller to a new location, your application should scroll the document a corresponding distance.
- For a click on a scroll arrow, you should scroll by a distance appropriate to your application. For example, a text editing application might scroll one line of text for one click in the vertical scroll bar.

- For a click in the gray area/track, you should scroll by a distance appropriate to your application. For example, a text editing application should ordinarily scroll by a distance equal to the height of the window less one text line.

Direction to scroll is determined by whether the scrolling distance is expressed as a positive or negative number. The scrolling distance will be expressed as a negative number if the user scrolls down from the beginning of the document, and as a positive number if the user scrolls up towards the beginning of the document.

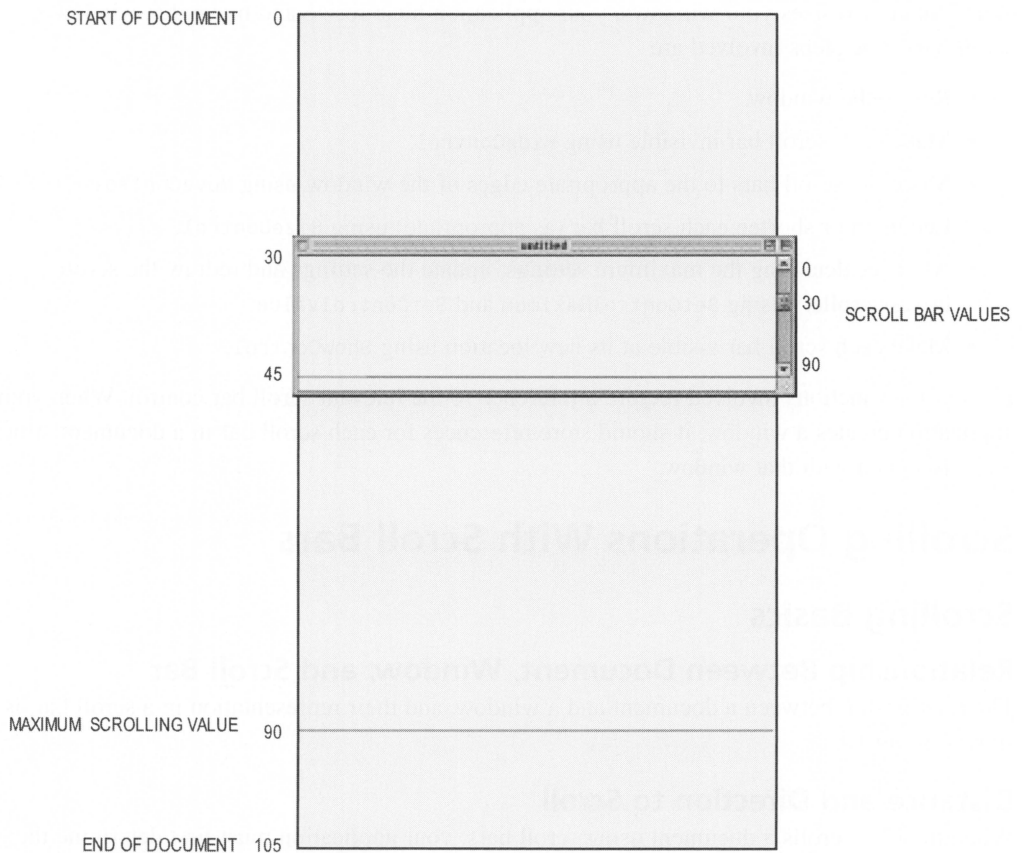


FIG 10 - RELATIONSHIP BETWEEN THE DOCUMENT, THE WINDOW, AND THE SCROLL BAR

## Scrolling the Pixels

With the distance and direction to scroll determined, the next step is to scroll the pixels displayed in the window by that distance and in that direction. Typically, `ScrollRect` is used for that purpose.

### Moving the Scroll Box/Scroller

If the user did not affect the scroll using the scroll box/scroller, the scroll box/scroller must then be repositioned using `SetControlValue`.

### Updating the Window

The final step is to either call a function which generates an update event or directly call your application's update function. Your application's update function should call `UpdateControls` (to update the scroll bars) and redraw the appropriate part of the document in the window.

### Scrolling Example

Half the complexity of scrolling lays in ensuring that that part of the document which is displayed in the window correlates with the scroll bar control value, and vice versa, at all times.

Consider the left-top of Fig 11. This newly opened document consists of 35 lines of text with a consistent line height of 10 pixels. The document is, therefore, 350 pixels long. The upper-left point of the document is identical to the window origin—that is, both are at (0,0).

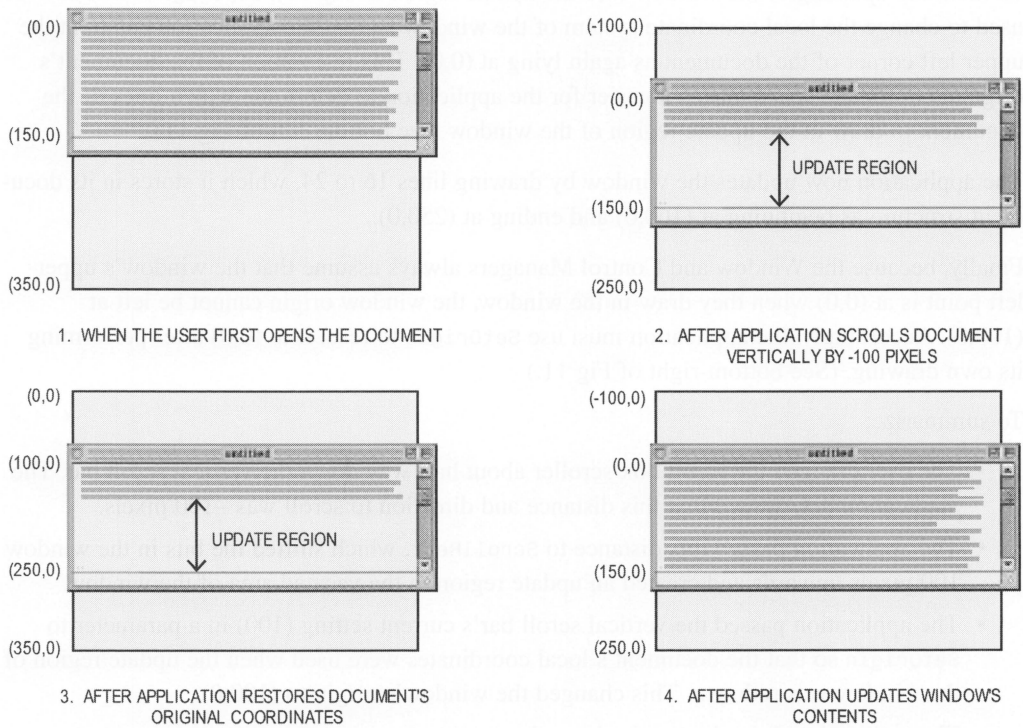


FIG 11 - SCROLLING A DOCUMENT IN A WINDOW



The window height is 150 pixels (15 lines of text). Thus the maximum setting for the scroll bar is equivalent to 200 pixels down in the document. (As shown in Fig 10, a vertical scroll bar's maximum setting equates to the length of the document minus the height of the window.)

Now assume that the user drags the scroll box/scroller *down* the vertical scroll bar. This means that your application must move the text *up* by the appropriate amount. Moving a document up means a negative scrolling value.

Suppose the application, using `GetControlValue`, determines that the scroll bar's control value is 100. The application must then call `ScrollRect` to shift the bits displayed in the window by a distance of -100 pixels (that is, 10 lines of text). As shown at the top-right of Fig 11, five lines from the bottom of the previous window display now appear at the top of the window.

Note that, in all this, `ScrollRect` does not change the coordinate system of the window; it simply moves the bits in the window to new coordinates that are still in the window's local coordinate system. In terms of the window's local coordinate system, then, the upper left corner of the document is now at (-100,0).

To facilitate updating of the window (see the update region in Fig 11), `SetOrigin` must now be used to change the local coordinate system of the window so that the application can treat the upper left corner of the document as again lying at (0,0). This restoration of the document's original coordinate space makes it easier for the application to determine which lines of the document to draw in the update region of the window (see bottom-left of Fig 11).

The application now updates the window by drawing lines 16 to 24, which it stores in its document structure as beginning at (160,0) and ending at (250,0).

Finally, because the Window and Control Managers always assume that the window's upper-left point is at (0,0) when they draw in the window, the window origin cannot be left at (100,0). Accordingly, the application must use `SetOrigin` to reset it to (0,0) after performing its own drawing, (See bottom-right of Fig 11.)

To summarize:

- The user dragged the scroll box/scroller about half way down the vertical scroll bar. The application determined that this distance and direction to scroll was -100 pixels.
- The application passed this distance to `ScrollRect`, which shifted the bits in the window 100 pixels upwards and created an update region in the vacated area of the window.
- The application passed the vertical scroll bar's current setting (100) in a parameter to `SetOrigin` so that the document's local coordinates were used when the update region of the window was redrawn. This changed the window's origin to (100,0).
- The application drew the text in the update region.
- The application reset the window's origin to (0,0).



## Alternative to SetOrigin

There are alternatives to the `SetOrigin` methodology. `SetOrigin` simply helps you to offset the window's origin by the scroll bar's current settings when you update the window so that you can locate objects in a document using a coordinate system where the upper-left corner of the document is always at (0,0).

As an alternative to this approach, your application can leave the upper-left corner of the window at (0,0) and instead offset the items in your document, using `OffsetRect`, by an amount equal to the scroll bar's settings.

## Scrolling a TextEdit Document and Scrolling Using the List Manager

TextEdit is a collection of functions and data structures which you can use to provide your application with basic text editing capabilities. Chapter 21 addresses the scrolling of TextEdit documents.

For scrolling lists of graphic or textual information, your application can use the List Manager to implement scroll bars (see Chapter 22).

## Small Versions of Controls

Human Interface Guidelines permit the use of small versions of certain controls, which should only be used when space is at a premium. Full size and small controls should not be mixed in the same window.

The following lists those controls described in this chapter that are available in small versions, and describes how to create them.

<i>Control</i>	<i>Mac OS X</i>	<i>Mac OS 8/9</i>
Push button	Make the control's rectangle 17 pixels high and call <code>SetControlFontStyle</code> to set the small system font.	Make the control's rectangle 17 pixels high and use <code>SetControlFontStyle</code> to set the small system font.
Radio button Checkbox	Call <code>SetControlData</code> with the <code>kControlSizeTag</code> tag to make the control proper small, and call <code>SetControlFontStyle</code> to set the title to the small system font.	(Not available.)

<i>Control</i>	<i>Mac OS X</i>	<i>Mac OS 8/9</i>
Pop-up menu button	Create the control from a 'CNTL' resource, specifying the <code>kControlPopupUseWFontVariant</code> , and set the owner window's font to the small system font.	Create the control from a 'CNTL' resource, specifying the <code>kControlPopupUseWFontVariant</code> , and set the owner window's font to the small system font.
Scroll bar	Call <code>SetControlData</code> with the <code>kControlSizeTag</code> tag to make the control small.	Make the control's rectangle 11 pixels wide (vertical scroll bars) or high (horizontal scroll bars).

Small scroll bars should only be used in floating windows. Fig 12 shows an example.

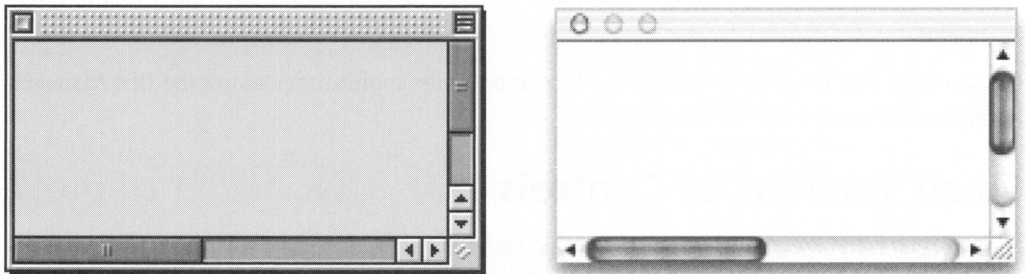


FIG 12 - SMALL SCROLL BARS IN A UTILITY (FLOATING) WINDOW

## Main Control Manager Constants, Data Types and Functions Relevant to the Basic Controls, Primary Group Box and User Panes

### Constants

#### Control Definition IDs

<code>kControlPushButtonProc</code>	= 368
<code>kControlPushButLeftIconProc</code>	= 374
<code>kControlPushButRightIconProc</code>	= 375
<code>kControlCheckBoxProc</code>	= 369
<code>kControlCheckBoxAutoToggleProc</code>	= 371
<code>kControlRadioButtonProc</code>	= 370
<code>kControlRadioButtonAutoToggleProc</code>	= 372
<code>kControlScrollBarProc</code>	= 384
<code>kControlScrollBarLiveProc</code>	= 386
<code>kControlPopupButtonProc</code>	= 400
<code>kControlGroupBoxTextTitleProc</code>	= 160
<code>kControlUserPaneProc</code>	= 256

## Push Button Icon Alignment

kControlPushButtonIconOnLeft	= 6
kControlPushButtonIconOnRight	= 7

## Pop-up Menu Button Variants

kControlPopupFixedWidthVariant	= 1 << 0
kControlPopupVariableWidthVariant	= 1 << 1
kControlPopupUseAddResMenuVariant	= 1 << 2
kControlPopupUseWFontVariant	= 1 << 3

## Pop-up Title Characteristics

popupTitleBold	= 1 << 8
popupTitleItalic	= 1 << 9
popupTitleUnderline	= 1 << 10
popupTitleOutline	= 1 << 11
popupTitleShadow	= 1 << 12
popupTitleCondense	= 1 << 13
popupTitleExtend	= 1 << 14
popupTitleNoStyle	= 1 << 15

## Control Variants

kControlNoVariant	= 0
kControlUsesOwningWindowsFontVariant	= 1 << 3

## Control Part Codes

kControlNoPart	= 0
kControlEntireControl	= 0
kControlLabelPart	= 1
kControlMenuPart	= 2
kControlCheckBoxPart	= 11
kControlRadioButtonPart	= 11
kControlUpButtonPart	= 20
kControlDownButtonPart	= 21
kControlPageUpPart	= 22
kControlPageDownPart	= 23
kControlIndicatorPart	= 129
kControlDisabledPart	= 254
kControlInactivePart	= 255

## Checkbox Value Constants

kControlCheckBoxUncheckedValue	= 0
kControlCheckBoxCheckedValue	= 1
kControlCheckBoxMixedValue	= 2

## Radio Button Value Constants

kControlRadioButtonUncheckedValue	= 0
kControlRadioButtonCheckedValue	= 1
kControlRadioButtonMixedValue	= 2

## Control Data Tag Constants

kControlPushButtonDefaultTag	= FOUR_CHAR_CODE('df1t')
kControlPushButtonCancelTag	= FOUR_CHAR_CODE('cncl')
kControlPopupButtonMenuRefTag	= FOUR_CHAR_CODE('mhan')

kControlPopupButtonMenuIDTag	= FOUR_CHAR_CODE('mnd')
kControlPopupButtonExtraHeightTag	= FOUR_CHAR_CODE('exht')
kControlGroupBoxTitleRectTag	= FOUR_CHAR_CODE('trec')

### Control Data Tag Constants (Mac OS X Only)

kControlKindTag	= FOUR_CHAR_CODE('kind')
kControlSizeTag	= FOUR_CHAR_CODE('size')

### Control Font Style Flag Constants

kControlUseFontMask	= 0x0001
kControlUseFaceMask	= 0x0002
kControlUseSizeMask	= 0x0004
kControlUseForeColorMask	= 0x0008
kControlUseBackColorMask	= 0x0010
kControlUseModeMask	= 0x0020
kControlUseJustMask	= 0x0040
kControlUseAllMask	= 0x00FF
kControlAddFontSizeMask	= 0x0100

### Meta Font Constants

kControlFontBigSystemFont	= -1
kControlFontSmallSystemFont	= -2
kControlFontSmallBoldSystemFont	= -3
kControlFontViewSystemFont	= -4

### Push Button Icon Alignment

kControlPushButtonIconOnLeft	= 6
kControlPushButtonIconOnRight	= 7

### Control Image Content

kControlContentIconSuiteRes	= 1
kControlContentCIconRes	= 2
kControlContentICONRes	= 4
kControlContentIconSuiteHandle	= 129
kControlContentCIconHandle	= 130
kControlContentPictHandle	= 131
kControlContentIconRef	= 132
kControlContentICON	= 133

### Control Kind (Mac OS X Only)

kControlKindPushButton	= 'push'
kControlKindPushIconButton	= 'picon'
kControlKindCheckBox	= 'cbox'
kControlKindRadioButton	= 'rdio'
kControlKindScrollBar	= 'sbar'
kControlKindPopupButton	= 'popb'
kControlKindGroupBox	= 'grpbox'
kControlKindUserPane	= 'upan'

## Data Types

```
typedef struct OpaqueControlRef* ControlRef;
typedef ControlRef ControlHandle;
typedef SInt16 ControlPartCode;
typedef UInt16 ControlPushButtonIconAlignment;
typedef SInt16 ControlContentType;
```

### Control Button Content Info

```
struct ControlButtonContentInfo
{
    ControlContentType contentType;
    union
    {
        SInt16 resID;
        CIconHandle cIconHandle;
        Handle iconSuite;
        IconRef iconRef;
        PicHandle picture;
        Handle ICONHandle;
    } u;
};
typedef struct ControlButtonContentInfo ControlButtonContentInfo;
typedef ControlButtonContentInfo *ControlButtonContentInfoPtr;
```

### Control Font Style

```
struct ControlFontStyleRec
{
    SInt16 flags;
    SInt16 font;
    SInt16 size;
    SInt16 style;
    SInt16 mode;
    SInt16 just;
    RGBColor foreColor;
    RGBColor backColor;
};
typedef struct ControlFontStyleRec ControlFontStyleRec;
typedef ControlFontStyleRec *ControlFontStylePtr;
```

### Control ID

```
struct ControlID
{
    OSType signature;
    SInt32 id;
};
typedef struct ControlIDControlID;
```

### ControlKind

```
struct ControlKind
{
    OSType signature;
    OSType kind;
};
typedef struct ControlKind ControlKind;
```

## Functions

### Creating Controls

```
ControlRef  GetNewControl(SInt16 controlId,WindowPtr owner);
ControlRef  NewControl(WindowPtr owningWindow,const Rect *boundsRect,ConstStr255Param
title,Boolean initiallyVisible,SInt16 initialValue,SInt16 minimumValue,
SInt16 maximumValue,SInt16 procID,SInt32 controlReference);
OSStatus    CreatePushButtonControl(WindowRef window,const Rect *boundsRect,
ConstStr255Param title,ControlRef *outControl);
OSStatus    CreatePushButtonWithIconControl(WindowRef window,const Rect *boundsRect,
ConstStr255Param title,ControlButtonContentInfo *icon,
ControlPushButtonIconAlignment iconAlignment,ControlRef *outControl);
OSStatus    CreateRadioButtonControl(WindowRef window, const Rect *boundsRect,
ConstStr255Param title,Boolean autoToggle,ControlRef *outControl);
OSStatus    CreateCheckBoxControl(WindowRef window,const Rect *boundsRect,
ConstStr255Param title,Boolean autoToggle,ControlRef *outControl);
OSStatus    CreateScrollBarControl(WindowRef window,Rect *boundsRect,
SInt32 value,SInt32 minimum,SInt32 maximum,SInt32 viewSize,
Boolean liveTracking,ControlActionUPP liveTrackingProc,
ControlRef *outControl);
OSStatus    CreatePopupButtonControl(WindowRef window,const Rect *boundsRect,
ConstStr255Param title,SInt16 menuID,Boolean variableWidth,SInt16 titleWidth,
SInt16 titleJustification,Style titleStyle,ControlRef *outControl);
OSStatus    CreateGroupBoxControl(WindowRef window,const Rect *boundsRect,
ConstStr255Param title,Boolean primary,ControlRef *outControl);
OSStatus    CreateUserPaneControl(WindowRef window,const Rect *boundsRect,
UInt32 features,ControlRef *outControl);
```

### Removing Controls

```
void        DisposeControl(ControlRef theControl);
void        KillControls(WindowPtr theWindow);
```

### Embedding Controls

```
OSErr       CreateRootControl(WindowPtr inWindow,ControlRef *outControl);
OSErr       GetRootControl(WindowPtr inWindow,ControlRef *outControl);
OSErr       EmbedControl(ControlRef inControl,ControlRef inContainer);
OSErr       AutoEmbedControl(ControlRef inControl,WindowPtr inWindow);
OSErr       CountSubControl(ControlRef inControl,SInt16 *outNumChildren);
OSErr       GetIndexedSubControl(ControlRef inControl,SInt16 inIndex,
ControlRef * outSubControl);
OSErr       GetSuperControl(ControlRef inControl,ControlRef *outParent);
OSErr       SetControlSupervisor(ControlRef inControl,ControlRef inBoss);
OSErr       DumpControlHierarchy(WindowPtr inWindow,const FSSpec *inDumpFile);
```

### Displaying and Manipulating Controls

```
void        MoveControl(ControlRef theControl,SInt16 h,SInt16 v);
void        SizeControl(ControlRef theControl,SInt16 w,SInt16 h);
void        UpdateControls(WindowPtr theWindow,RgnHandle updateRgn);
void        DrawControls(WindowPtr theWindow);
void        DrawOneControl(ControlRef theControl);
void        DrawControlInCurrentPort(ControlRef inControl);
Boolean     IsControlActive (ControlRef inControl);
OSErr       ActivateControl (ControlRef inControl);
OSErr       DeactivateControl(ControlRef inControl);
```

```

Boolean    IsControlVisible(ControlRef inControl);
void       HideControl(ControlRef theControl);
void       ShowControl(ControlRef theControl);
OSErr      SetControlVisibility (ControlRef inControl, Boolean inIsVisible,
                                Boolean inDoDraw);
OSErr      SendControlMessage(ControlRef inControl, SInt16 inMessage, SInt32 inParam);
void       DragControl(ControlRef theControl, Point startPt, const Rect *limitRect,
                                const Rect *slopRect, DragConstraint axis);
Boolean    IsControlHilited(ControlRef control);
void       HiliteControl(ControlRef theControl, ControlPartCode hiliteState);

```

## Enabling and Disabling Controls (Mac OS X Only)

```

OSStatus   EnableControl(ControlRef inControl);
OSStatus   DisableControl(ControlRef inControl);
Boolean    IsControlEnabled(ControlRef inControl);

```

## Handling Events in Controls

```

ControlPartCode FindControl(Point thePoint, WindowPtr theWindow, ControlRef *theControl);
ControlRef       FindControlUnderMouse(Point inWhere, WindowPtr inWindow,
                                        SInt16 *outPart);
ControlPartCode  TrackControl(ControlRef theControl, Point thePoint,
                                ControlActionUPP actionProc);
SInt16           HandleControlClick(ControlRef inControl, Point inWhere, SInt16 inModifiers,
                                    ControlActionUPP nAction);
ControlPartCode  TestControl(ControlRef theControl, Point thePt);

```

## Accessing and Changing Control Settings and Data

```

WindowPtr  GetControlOwner(ControlRef control);
void       SetControlOwner(ControlRef control, WindowPtr owner);
Rect *     GetControlBounds(ControlRef control, Rect *bounds);
void       SetControlBounds(ControlRef control, const Rect *bounds);
Boolean    IsControlHilited(ControlRef control);
UInt16     GetControlHilite(ControlRef control);
Handle     GetControlDefinition(ControlRef control);
Handle     GetControlDataHandle(ControlRef control);
void       SetControlDataHandle(ControlRef control, Handle dataHandle);
MenuHandle GetControlPopupMenuHandle(ControlRef control);
void       SetControlPopupMenuHandle(ControlRef control, MenuHandle popupMenu);
short      GetControlPopupMenuID(ControlRef control);
void       SetControlPopupMenuID(ControlRef control, short menuID);
SInt16     GetControlValue(ControlRef theControl);
void       SetControlValue(ControlRef theControl, SInt16 theValue);
SInt16     GetControlMinimum(ControlRef theControl);
void       SetControlMinimum(ControlRef theControl, SInt16 newMinimum);
SInt16     GetControlMaximum(ControlRef theControl);
void       SetControlMaximum(ControlRef theControl, SInt16 newMaximum);
SInt32     GetControl32BitValue(ControlRef theControl);
void       SetControl32BitValue(ControlRef theControl, SInt32 newValue);
SInt32     GetControl32BitMaximum(ControlRef theControl);
void       SetControl32BitMaximum(ControlRef theControl, SInt32 newMaximum);
SInt32     GetControl32BitMinimum(ControlRef theControl);
void       SetControl32BitMinimum(ControlRef theControl, SInt32 newMinimum);
void       GetControlTitle(ControlRef theControl, Str255 title);
void       SetControlTitle(ControlRef theControl, ConstStr255Param title);
OSStatus   SetControlTitleWithCFString(ControlRef inControl, CFStringRef inString);

```



```

SInt32      GetControlReference(ControlRef theControl);
void        SetControlReference(ControlRef theControl,SInt32 data);
ControlActionUPP GetControlAction(ControlRef theControl);
void        SetControlAction(ControlRef theControl,ControlActionUPP actionProc);
SInt32      GetControlViewSize(ControlRef theControl);
void        SetControlViewSize(ControlRef theControl,SInt32 newViewSize);
SInt16      GetControlVariant(ControlRef theControl);
OSErr       SetControlData(ControlRef inControl,ControlPartCode inPart,
                          ResType inTagName,Size inSize,Ptr inData);
OSErr       GetControlData (ControlRef inControl,ControlPartCode inPart,
                          ResType inTagName,Size inBufferSize,Ptr inBuffer,Size *outActualSize);
OSErr       GetControlDataSize(ControlRef inControl,ControlPartCode inPart,
                          ResType inTagName,Size *outMaxSize);
OSErr       SetControlVisibility(ControlRef inControl,Boolean inIsVisible,
                          Boolean inDoDraw);

```

### Setting the Control Font Style

```

OSErr       SetControlFontStyle(ControlRef inControl,const ControlFontStyleRec *inStyle);

```

### Setting and Getting Control IDs

```

OSStatus     SetControlID(ControlRef inControl,const ControlID *inID);
OSStatus     GetControlID(ControlRef inControl,ControlID *outID);
OSStatus     GetControlByID(WindowRef inWindow,const ControlID *inID,ControlRef *outControl);

```

### Getting Control Kind (Mac OS X Only)

```

OSStatus     GetControlKind(ControlRef inControl,ControlKind *outControlKind);

```

### Creating and Disposing of Universal Procedure Pointers for Control Action Functions

```

ControlActionUPP NewControlActionUPP(ControlActionProcPtr userRoutine);
void             DisposeControlActionUPP(ControlActionUPP userUPP);

```

### Application-Defined (Callback) Function

```

void          myControlActionFunction(ControlRef theControl,ControlPartCode partCode);

```

## Demonstration Program Controls1 Listing

```

// *****
// Controls1.c                                     CLASSIC EVENT MODEL
// *****
//
// This program opens a kWindowFullZoomGrowDocumentProc window containing:
//
// · Three pop-up menu buttons (fixed width, variable width and use window font variants).
//
// · Three non-auto-toggling radio buttons auto-embedded in a primary group box (text title variant).
//
// · Three non-auto-toggling checkboxes auto-embedded in a primary group box (text title variant).
//
// · Four push buttons (two basic, one left color icon variant, and one right color icon variant).
//

```

```

// · A vertical scroll bar (non live-feedback variant) and a horizontal scroll bar (live-
//   feedback variant).
//
// Some controls are created using 'CNTL' resources. Others are created programmatically.
//
// The window also contains a window header frame in which is displayed:
//
// · The menu items chosen from the pop-up menus.
//
// · The identity of a push button when that push button is clicked.
//
// · Scroll bar control values when the scroll arrows or gray areas/tracks of the scroll bars
//   are clicked and when the scroll box/scroller is dragged.
//
// The scroll bars are moved and resized when the user resizes or zooms the window; however,
// the scroll bars do not scroll the window contents.
//
// A Demonstration menu allows the user to deactivate the group boxes in which the radio
// buttons and checkboxes are embedded.
//
// The program utilises the following resources:
//
// · A 'plst' resource.
//
// · An 'MBAR' resource, and 'MENU' resources for Apple, File, Edit, and Demonstration menus,
//   and the pop-up menus (preload, non-purgeable).
//
// · A 'WIND' resource (purgeable) (initially not visible).
//
// · 'CNTL' resources for those controls not created programmatically.
//
// · Two 'cicn' resources (purgeable) for the color icon variant buttons.
//
// · An 'hrct' resource and an 'hwin' resource (both purgeable), which provide help balloons
//   describing the various controls.
//
// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****
// ..... includes
#include <Carbon.h>
#include <string.h>

// ..... defines

#define rMenubar          128
#define rWindow           128
#define mAppleApplication 128
#define iAbout            1
#define mFile             129
#define iQuit             12
#define mDemonstration    131
#define iColor            1

```

```

#define iGrids                2
#define cPopupFixed           128
#define cPopupWinFont         129
#define cRadiobuttonRed       130
#define cRadiobuttonBlue      131
#define cCheckboxGrid         132
#define cCheckboxGridsnap     133
#define cGroupBoxColor        134
#define cButton               135
#define cButtonLeftIcon       136
#define cScrollbarVert        137
#define kScrollBarWidth       15
#define MAX_UINT32             0xFFFFFFFF
#define MIN(a,b)               ((a) < (b) ? (a) : (b))

// ..... typedefs

typedef struct
{
    ControlRef popupFixedRef;
    ControlRef popupVariableRef;
    ControlRef popupWinFontRef;
    ControlRef groupBoxColorRef;
    ControlRef groupBoxGridsRef;
    ControlRef buttonRef;
    ControlRef buttonDefaultRef;
    ControlRef buttonLeftIconRef;
    ControlRef buttonRightIconRef;
    ControlRef radiobuttonRedRef;
    ControlRef radiobuttonWhiteRef;
    ControlRef radiobuttonBlueRef;
    ControlRef checkboxGridRef;
    ControlRef checkboxRulersRef;
    ControlRef checkboxGridSnapRef;
    ControlRef scrollbarVertRef;
    ControlRef scrollbarHorizRef;
} docStruc;

typedef docStruc **docStrucHandle;

// ..... global variables

ControlActionUPP gActionFunctionVertUPP;
ControlActionUPP gActionFunctionHorizUPP;
Boolean          gRunningOnX = false;
WindowRef        gWindowRef;
Boolean          gDone;
Boolean          gInBackground = false;
Str255          gCurrentString;

// ..... function prototypes

void main                (void);
void doPreliminaries     (void);
OSErr quitAppEventHandler (AppleEvent *, AppleEvent *, SInt32);

```

```

void doGetControls      (WindowRef);
void doEvents          (EventRecord *);
void doMouseDown       (EventRecord *);
void doMenuChoice      (SInt32);
void doUpdate          (EventRecord *);
void doActivate        (EventRecord *);
void doActivateWindow  (WindowRef, Boolean);
void doOSEvent         (EventRecord *);
void doInContent       (EventRecord *, WindowRef);
void doPopupMenuChoice (WindowRef, ControlRef, SInt16);
void doVertScrollbar   (ControlPartCode, WindowRef, ControlRef, Point);
void actionFunctionVert (ControlRef, ControlPartCode);
void actionFunctionHoriz (ControlRef, ControlPartCode);
void doMoveScrollBar  (ControlRef, SInt16);
void doRadioButtons    (ControlRef, WindowRef);
void doCheckboxes      (ControlRef);
void doPushButtons    (ControlRef, WindowRef);
void doAdjustScrollBars (WindowRef);
void doDrawMessage     (WindowRef, Boolean);
void doConcatPStrings  (Str255, Str255);
void doCopyPString     (Str255, Str255);
void helpTags          (WindowRef);

```

```
// ***** main
```

```

void main(void)
{
    MenuBarHandle  menubarHdl;
    SInt32         response;
    MenuRef        menuRef;
    docStrucHandle docStrucHdl;
    EventRecord    EventStructure;

    // ..... do preliminaries

    doPreliminaries();

    // ..... create universal procedure pointers

    gActionFunctionVertUPP = NewControlActionUPP((ControlActionProcPtr) actionFunctionVert);
    gActionFunctionHorizUPP = NewControlActionUPP((ControlActionProcPtr) actionFunctionHoriz);

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMMenuBar);
    if(menubarHdl == NULL)
        ExitToShell();
    SetMenuBar(menubarHdl);
    DrawMenuBar();

    Gestalt(gestaltMenuMgrAttr, &response);
    if(response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)

```

```

    {
        DeleteMenuItem(menuRef,iQuit);
        DeleteMenuItem(menuRef,iQuit - 1);
        DisableMenuItem(menuRef,0);
    }

    gRunningOnX = true;
}

// ..... initial advisory text for window header
doCopyPString("\pBalloon and Help tag help is available",gCurrentString);

// ..... open a window, set font size, set Appearance-compliant color/pattern for window
if(!(gWindowRef = GetNewCWindow(rWindow,NULL,(WindowRef) -1)))
    ExitToShell();

SetPortWindowPort(gWindowRef);
UseThemeFont(kThemeSmallSystemFont,smSystemScript);

SetThemeWindowBackground(gWindowRef,kThemeBrushDialogBackgroundActive,false);

// ..... get block for document structure, assign handle to window record refCon field
if(!(docStrucHdl = (docStrucHandle) NewHandle(sizeof(docStruc))))
    ExitToShell();

SetWRefCon(gWindowRef,(SInt32) docStrucHdl);

// ..... get controls, adjust scroll bars, get help tags, and show window
doGetControls(gWindowRef);
doAdjustScrollBars(gWindowRef);

if(gRunningOnX)
    helpTags(gWindowRef);

ShowWindow(gWindowRef);

// ..... enter eventLoop

gDone = false;

while(!gDone)
{
    if(WaitNextEvent(everyEvent,&EventStructure,MAX_UINT32,NULL))
        doEvents(&EventStructure);
}
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    OSErr osError;

```

```

MoreMasterPointers(128);
InitCursor();
FlushEvents(everyEvent,0);

osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
                               NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
                               0L,false);

if(osError != noErr)
    ExitToShell();
}

// ***** doQuitAppEvent

OSErr quitAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,SInt32 handlerRefcon)
{
    OSErr    osError;
    DescType returnedType;
    Size     actualSize;

    osError = AEGetAttributePtr(appEvent,keyMissedKeywordAttr,typeWildCard,&returnedType,NULL,0,
                               &actualSize);

    if(osError == errAEDescNotFound)
    {
        gDone = true;
        osError = noErr;
    }
    else if(osError == noErr)
        osError = errAEParamMissed;

    return osError;
}

// ***** doGetControls

void doGetControls(WindowRef windowRef)
{
    ControlRef      controlRef;
    docStrucHandle  docStrucHdl;
    OSStatus        osError;

    Rect popupVariableRect = { 73, 25, 93,245 };
    Rect radioButtonWhiteRect = { 183, 35,201, 92 };
    Rect checkBoxRulersRect = { 183,138,201,242 };
    Rect groupBoxGridsRect = { 136,123,236,252 };
    Rect buttonDefaultRect = { 252,141,272,210 };
    Rect buttonRightIconRect = { 285,141,305,220 };
    Rect scrollbarVertRect = { 0, 0, 16,100 };
    ControlButtonContentInfo buttonContentInfo;
    Boolean booleanData = true;
    ControlFontStyleRec controlFontStyleStruc;

    if(!gRunningOnX)
        CreateRootControl(windowRef,&controlRef);

    docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));

```

```

// ..... popup menu buttons

if(!((*docStrucHdl)->popupFixedRef = GetNewControl(cPopupFixed>windowRef)))
    ExitToShell();

if((osError = CreatePopupButtonControl>windowRef,&popupVariableRect,CFSTR("Time Zone:"),
    132,true,76,popupTitleLeftJust,popupTitleNoStyle,
    &(*docStrucHdl)->popupVariableRef)) == noErr)
    ShowControl((*docStrucHdl)->popupVariableRef);
else
    ExitToShell();

if(!((*docStrucHdl)->popupWinFontRef = GetNewControl(cPopupWinFont>windowRef)))
    ExitToShell();

// ..... radio buttons

if(!((*docStrucHdl)->radiobuttonRedRef = GetNewControl(cRadiobuttonRed>windowRef)))
    ExitToShell();

if((osError = CreateRadioButtonControl>windowRef,&radioButtonWhiteRect,CFSTR("White"),0,
    false,&(*docStrucHdl)->radiobuttonWhiteRef)) == noErr)
    ShowControl((*docStrucHdl)->radiobuttonWhiteRef);
else
    ExitToShell();

if(!((*docStrucHdl)->radiobuttonBlueRef = GetNewControl(cRadiobuttonBlue>windowRef)))
    ExitToShell();

// ..... checkboxes

if(!((*docStrucHdl)->checkboxGridRef = GetNewControl(cCheckboxGrid>windowRef)))
    ExitToShell();

if((osError = CreateCheckBoxControl>windowRef,&checkboxRulersRect,CFSTR("Rulers"),0,false,
    &(*docStrucHdl)->checkboxRulersRef)) == noErr)
    ShowControl((*docStrucHdl)->checkboxRulersRef);
else
    ExitToShell();

if(!((*docStrucHdl)->checkboxGridSnapRef = GetNewControl(cCheckboxGridsnap>windowRef)))
    ExitToShell();

// ..... group boxes

if(!((*docStrucHdl)->groupboxColorRef = GetNewControl(cGroupBoxColor>windowRef)))
    ExitToShell();

if((osError = CreateGroupBoxControl>windowRef,&groupboxGridsRect,CFSTR("Grids"),true,
    &(*docStrucHdl)->groupboxGridsRef)) == noErr)
    ShowControl((*docStrucHdl)->groupboxGridsRef);
else
    ExitToShell();

```



```
// ..... push buttons

if(!((*docStrucHdl)->buttonRef = GetNewControl(cButton,windowRef)))
    ExitToShell();

if((osError = CreatePushButtonControl(windowRef,&buttonDefaultRect,CFSTR("OK"),
                                     &(*docStrucHdl)->buttonDefaultRef)) == noErr)
    ShowControl((*docStrucHdl)->buttonDefaultRef);
else
    ExitToShell();

if(!((*docStrucHdl)->buttonLeftIconRef = GetNewControl(cButtonLeftIcon,windowRef)))
    ExitToShell();

buttonContentInfo.contentType = kControlContentCIconRes;
buttonContentInfo.u.resID = 101;
if((osError = CreatePushButtonWithIconControl(windowRef,&buttonRightIconRect,
                                              CFSTR("Button"),&buttonContentInfo,
                                              kControlPushButtonIconOnRight,
                                              &(*docStrucHdl)->buttonRightIconRef)) == noErr)
    ShowControl((*docStrucHdl)->buttonRightIconRef);
else
    ExitToShell();

// ..... scroll bars

if(!((*docStrucHdl)->scrollbarVertRef = GetNewControl(cScrollbarVert,windowRef)))
    ExitToShell();

if((osError = CreateScrollBarControl(windowRef,&scrollbarVertRect,0,0,100,100,true,
                                     gActionFunctionHorizUPP,
                                     &(*docStrucHdl)->scrollbarHorizRef)) == noErr)
    ShowControl((*docStrucHdl)->scrollbarHorizRef);
else
    ExitToShell();

// .....

AutoEmbedControl((*docStrucHdl)->radiobuttonRedRef,windowRef);
AutoEmbedControl((*docStrucHdl)->radiobuttonWhiteRef,windowRef);
AutoEmbedControl((*docStrucHdl)->radiobuttonBlueRef,windowRef);
AutoEmbedControl((*docStrucHdl)->checkboxGridRef,windowRef);
AutoEmbedControl((*docStrucHdl)->checkboxRulersRef,windowRef);
AutoEmbedControl((*docStrucHdl)->checkboxGridSnapRef,windowRef);

SetControlData((*docStrucHdl)->buttonDefaultRef,kControlEntireControl,
               kControlPushButtonDefaultTag,sizeof(booleanData),&booleanData);

controlFontStyleStruc.flags = kControlUseFontMask;
controlFontStyleStruc.font = kControlFontSmallSystemFont;
SetControlFontStyle((*docStrucHdl)->buttonLeftIconRef,&controlFontStyleStruc);
controlFontStyleStruc.font = kControlFontSmallBoldSystemFont;
SetControlFontStyle((*docStrucHdl)->buttonRightIconRef,&controlFontStyleStruc);

DeactivateControl((*docStrucHdl)->checkboxRulersRef);
}
```

```
// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    SInt32      menuChoice;
    MenuID      menuID;
    MenuItemIndex menuItem;

    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEProcessAppleEvent(eventStrucPtr);
            break;

        case keyDown:
            if((eventStrucPtr->modifiers & cmdKey) != 0)
            {
                menuChoice = MenuEvent(eventStrucPtr);
                menuID = HiWord(menuChoice);
                menuItem = LoWord(menuChoice);
                if(menuID == mFile && menuItem == iQuit)
                    gDone = true;
            }
            break;

        case mouseDown:
            doMouseDown(eventStrucPtr);
            break;

        case updateEvt:
            doUpdate(eventStrucPtr);
            break;

        case activateEvt:
            doActivate(eventStrucPtr);
            break;

        case osEvt:
            doOSEvent(eventStrucPtr);
            break;
    }
}

// ***** doMouseDown

void doMouseDown(EventRecord *eventStrucPtr)
{
    WindowPartCode partCode, zoomPart;
    WindowRef      windowRef;
    Rect           constraintRect, mainScreenRect, portRect;
    BitMap         screenBits;
    Point          standardStateHeightAndWidth;
```

```

partCode = FindWindow(eventStrucPtr->where,&windowRef);

switch(partCode)
{
    case inMenuBar:
        doMenuChoice(MenuSelect(eventStrucPtr->where));
        break;

    case inContent:
        if(windowRef != FrontWindow())
            SelectWindow(windowRef);
        else
            doInContent(eventStrucPtr,windowRef);
        break;

    case inDrag:
        DragWindow(windowRef,eventStrucPtr->where,NULL);
        break;

    case inGoAway:
        if(TrackGoAway(windowRef,eventStrucPtr->where) == true)
            gDone = true;
        break;

    case inGrow:
        constraintRect.top    = 341;
        constraintRect.left   = 287;
        constraintRect.bottom = constraintRect.right = 32767;
        ResizeWindow(windowRef,eventStrucPtr->where,&constraintRect,NULL);
        doAdjustScrollBars(windowRef);
        doDrawMessage(windowRef,true);
        break;

    case inZoomIn:
    case inZoomOut:
        mainScreenRect = GetQDGlobalsScreenBits(&screenBits)->bounds;
        standardStateHeightAndWidth.v = mainScreenRect.bottom - 75;
        standardStateHeightAndWidth.h = 600;

        if(IsWindowInStandardState(windowRef,&standardStateHeightAndWidth,NULL))
            zoomPart = inZoomIn;
        else
            zoomPart = inZoomOut;

        if(TrackBox(windowRef,eventStrucPtr->where,partCode))
        {
            GetWindowPortBounds(windowRef,&portRect);
            EraseRect(&portRect);
            ZoomWindowIdeal(windowRef,zoomPart,&standardStateHeightAndWidth);
            doAdjustScrollBars(windowRef);
        }
        break;
}
}

```

```
// ***** doMenuChoice

void doMenuChoice(SInt32 menuChoice)
{
    MenuID      menuID;
    MenuItemIndex menuItem;
    MenuRef      menuRef;
    WindowRef    windowRef;
    docStrucHandle docStrucHdl;

    menuID = HiWord(menuChoice);
    menuItem = LoWord(menuChoice);

    if(menuID == 0)
        return;

    switch(menuID)
    {
        case mAppleApplication:
            if(menuItem == iAbout)
                SysBeep(10);
            break;

        case mFile:
            if(menuItem == iQuit)
                gDone = true;
            break;

        case mDemonstration:
            menuRef = GetMenuRef(mDemonstration);
            windowRef = FrontWindow();
            docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));

            if(menuItem == iColor)
            {
                if(IsControlVisible((*docStrucHdl)->groupboxColorRef))
                {
                    HideControl((*docStrucHdl)->groupboxColorRef);
                    SetMenuItemText(menuRef, iColor, "\pShow Color");
                }
                else
                {
                    ShowControl((*docStrucHdl)->groupboxColorRef);
                    SetMenuItemText(menuRef, iColor, "\pHide Color");
                }
            }
            else if(menuItem == iGrids)
            {
                if(IsControlActive((*docStrucHdl)->groupboxGridsRef))
                {
                    DeactivateControl((*docStrucHdl)->groupboxGridsRef);
                    SetMenuItemText(menuRef, iGrids, "\pActivate Grids");
                }
            }
    }
}
```

```

        else
        {
            ActivateControl((*docStrucHdl)->groupboxGridsRef);
            SetMenuItemText(menuRef,iGrids,"\\pDeactivate Grids");
        }
    }
    break;
}

HiliteMenu(0);
}

// ***** doUpdate

void doUpdate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    RgnHandle regionHdl;

    windowRef = (WindowRef) eventStrucPtr->message;

    BeginUpdate(windowRef);

    SetPortWindowPort(windowRef);
    doDrawMessage(windowRef,!gInBackground);

    if(regionHdl = NewRgn())
    {
        GetPortVisibleRegion(GetWindowPort(windowRef),regionHdl);
        UpdateControls(windowRef,regionHdl);
        DisposeRgn(regionHdl);
    }

    EndUpdate(windowRef);
}

// ***** doActivate

void doActivate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    Boolean becomingActive;

    windowRef = (WindowRef) eventStrucPtr->message;
    becomingActive = ((eventStrucPtr->modifiers & activeFlag) == activeFlag);
    doActivateWindow(windowRef,becomingActive);
}

// ***** doActivateWindow

void doActivateWindow(WindowRef windowRef,Boolean becomingActive)
{
    ControlRef controlRef;

```

```

    GetRootControl(windowRef,&controlRef);

    if(becomingActive)
    {
        ActivateControl(controlRef);
        doDrawMessage(windowRef,becomingActive);
    }
    else
    {
        DeactivateControl(controlRef);
        doDrawMessage(windowRef,becomingActive);
    }
}

// ***** doOSEvent

void doOSEvent(EventRecord *eventStrucPtr)
{
    switch((eventStrucPtr->message >> 24) & 0x000000FF)
    {
        case suspendResumeMessage:
            if((eventStrucPtr->message & resumeFlag) == 1)
            {
                SetThemeCursor(kThemeArrowCursor);
                gInBackground = false;
            }
            else
                gInBackground = true;
            break;
    }
}

// ***** doInContent

void doInContent(EventRecord *eventStrucPtr,WindowRef windowRef)
{
    docStrucHandle docStrucHdl;
    ControlRef      controlRef;
    SInt16          controlValue, controlPartCode;

    docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));

    SetPortWindowPort(windowRef);
    GlobalToLocal(&eventStrucPtr->where);

    if(controlPartCode = FindControl(eventStrucPtr->where,windowRef,&controlRef))
    {
        if(controlRef == (*docStrucHdl->popupFixedRef ||
            controlRef == (*docStrucHdl->popupVariableRef ||
            controlRef == (*docStrucHdl->popupWinFontRef)
        {
            TrackControl(controlRef,eventStrucPtr->where,(ControlActionUPP) -1);
            controlValue = GetControlValue(controlRef);
            doPopupMenuChoice(windowRef,controlRef,controlValue);
        }
    }
}

```

```

else if(controlRef == (*docStrucHdl)->scrollbarVertRef)
{
    doVertScrollbar(controlPartCode,windowRef,controlRef,eventStrucPtr->where);
}
else if(controlRef == (*docStrucHdl)->scrollbarHorizRef)
{
    TrackControl(controlRef,eventStrucPtr->where,gActionFunctionHorizUPP);
}
else
{
    if(TrackControl(controlRef,eventStrucPtr->where,NULL))
    {
        if(controlRef == (*docStrucHdl)->radiobuttonRedRef ||
            controlRef == (*docStrucHdl)->radiobuttonWhiteRef ||
            controlRef == (*docStrucHdl)->radiobuttonBlueRef)
        {
            doRadioButtons(controlRef,windowRef);
        }
        if(controlRef == (*docStrucHdl)->checkboxGridRef ||
            controlRef == (*docStrucHdl)->checkboxRulersRef ||
            controlRef == (*docStrucHdl)->checkboxGridSnapRef)
        {
            doCheckboxes(controlRef);
        }
        if(controlRef == (*docStrucHdl)->buttonRef ||
            controlRef == (*docStrucHdl)->buttonDefaultRef ||
            controlRef == (*docStrucHdl)->buttonLeftIconRef ||
            controlRef == (*docStrucHdl)->buttonRightIconRef)
        {
            doPushButtons(controlRef,windowRef);
        }
    }
}
}
}

// ***** doPopupMenuChoice

void doPopupMenuChoice(WindowRef windowRef,ControlRef controlRef,SInt16 controlValue)
{
    MenuRef menuRef;
    Size    actualSize;

    GetControlData(controlRef,kControlEntireControl,kControlPopupMenuHandleTag,
        sizeof(menuRef),&menuRef,&actualSize);
    GetMenuItemText(menuRef,controlValue,gCurrentString);
    doDrawMessage(windowRef,true);
}

// ***** doVertScrollbar

void doVertScrollbar(ControlPartCode controlPartCode,WindowRef windowRef,
    ControlRef controlRef,Point mouseXY)
{
    Str255 valueString;

```



```

doCopyPString("\pScroll Bar Control Value: ",gCurrentString);

switch(controlPartCode)
{
    case kControlIndicatorPart:
        if(TrackControl(controlRef,mouseXY,NULL))
        {
            NumToString((SInt32) GetControlValue(controlRef),valueString);
            doConcatPStrings(gCurrentString,valueString);
            doDrawMessage(windowRef,true);
        }
        break;

    case kControlUpButtonPart:
    case kControlDownButtonPart:
    case kControlPageUpPart:
    case kControlPageDownPart:
        TrackControl(controlRef,mouseXY,gActionFunctionVertUPP);
        break;
}
}

// ***** actionFunctionVert

void actionFunctionVert(ControlRef controlRef,ControlPartCode controlPartCode)
{
    SInt16    scrollDistance, controlValue;
    Str255    valueString;
    WindowRef windowRef;

    doCopyPString("\pScroll Bar Control Value: ",gCurrentString);

    if(controlPartCode)
    {
        switch(controlPartCode)
        {
            case kControlUpButtonPart:
            case kControlDownButtonPart:
                scrollDistance = 2;
                break;

            case kControlPageUpPart:
            case kControlPageDownPart:
                scrollDistance = 55;
                break;
        }

        if((controlPartCode == kControlDownButtonPart) ||
            (controlPartCode == kControlPageDownPart))
            scrollDistance = -scrollDistance;

        controlValue = GetControlValue(controlRef);
        if(((controlValue == GetControlMaximum(controlRef)) && scrollDistance < 0) ||
            ((controlValue == GetControlMinimum(controlRef)) && scrollDistance > 0))
            return;
    }
}

```

```

doMoveScrollBar(controlRef,scrollDistance);

NumToString((SInt32) GetControlValue(controlRef),valueString);
doConcatPStrings(gCurrentString,valueString);
windowRef = GetControlOwner(controlRef);
doDrawMessage(windowRef,true);
}
}

// ***** actionFunctionHoriz *****

void actionFunctionHoriz(ControlRef controlRef,ControlPartCode controlPartCode)
{
    SInt16    scrollDistance, controlValue;
    Str255    valueString;
    WindowRef windowRef;

    doCopyPString("\pScroll Bar Control Value: ",gCurrentString);

    if(controlPartCode != kControlIndicatorPart)
    {
        switch(controlPartCode)
        {
            case kControlUpButtonPart:
            case kControlDownButtonPart:
                scrollDistance = 2;
                break;

            case kControlPageUpPart:
            case kControlPageDownPart:
                scrollDistance = 55;
                break;
        }

        if((controlPartCode == kControlDownButtonPart) ||
            (controlPartCode == kControlPageDownPart))
            scrollDistance = -scrollDistance;

        controlValue = GetControlValue(controlRef);
        if(((controlValue == GetControlMaximum(controlRef)) && scrollDistance < 0) ||
            ((controlValue == GetControlMinimum(controlRef)) && scrollDistance > 0))
            return;

        doMoveScrollBar(controlRef,scrollDistance);
    }

    NumToString((SInt32) GetControlValue(controlRef),valueString);
    doConcatPStrings(gCurrentString,valueString);
    windowRef = GetControlOwner(controlRef);
    doDrawMessage(windowRef,true);
}

```

```

// ***** doMoveScrollBar

void doMoveScrollBar(ControlRef controlRef, Sint16 scrollDistance)
{
    Sint16 oldControlValue, controlValue, controlMax;

    oldControlValue = GetControlValue(controlRef);
    controlMax = GetControlMaximum(controlRef);

    controlValue = oldControlValue - scrollDistance;

    if(controlValue < 0)
        controlValue = 0;
    else if(controlValue > controlMax)
        controlValue = controlMax;

    SetControlValue(controlRef, controlValue);
}

// ***** doRadioButtons

void doRadioButtons(ControlRef controlRef, WindowRef windowRef)
{
    docStrucHandle docStrucHdl;

    docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));

    SetControlValue((*docStrucHdl)->radiobuttonRedRef, kControlRadioButtonUncheckedValue);
    SetControlValue((*docStrucHdl)->radiobuttonWhiteRef, kControlRadioButtonUncheckedValue);
    SetControlValue((*docStrucHdl)->radiobuttonBlueRef, kControlRadioButtonUncheckedValue);
    SetControlValue(controlRef, kControlRadioButtonCheckedValue);
}

// ***** doCheckboxes

void doCheckboxes(ControlRef controlRef)
{
    SetControlValue(controlRef, !GetControlValue(controlRef));
}

// ***** doPushButtons

void doPushButtons(ControlRef controlRef, WindowRef windowRef)
{
    docStrucHandle docStrucHdl;

    docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));

    if(controlRef == (*docStrucHdl)->buttonRef)
    {
        doCopyPString("\pButton", gCurrentString);
        doDrawMessage(windowRef, true);
    }
}

```

```

else if(controlRef == (*docStrucHdl)->buttonDefaultRef)
{
    doCopyPString("\pDefault Button",gCurrentString);
    doDrawMessage(windowRef,true);
}
else if(controlRef == (*docStrucHdl)->buttonLeftIconRef)
{
    doCopyPString("\pLeft Icon Button",gCurrentString);
    doDrawMessage(windowRef,true);
}
else if(controlRef == (*docStrucHdl)->buttonRightIconRef)
{
    doCopyPString("\pRight Icon Button",gCurrentString);
    doDrawMessage(windowRef,true);
}
}

// ***** doAdjustScrollBars

void doAdjustScrollBars(WindowRef windowRef)
{
    Rect          portRect;
    docStrucHandle docStrucHdl;

    docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));

    GetWindowPortBounds(windowRef,&portRect);

    HideControl((*docStrucHdl)->scrollbarVertRef);
    HideControl((*docStrucHdl)->scrollbarHorizRef);

    MoveControl((*docStrucHdl)->scrollbarVertRef,portRect.right - kScrollBarWidth,
        portRect.top + 25);
    MoveControl((*docStrucHdl)->scrollbarHorizRef,portRect.left - 1,
        portRect.bottom - kScrollBarWidth);

    SizeControl((*docStrucHdl)->scrollbarVertRef,16, portRect.bottom - 39);
    SizeControl((*docStrucHdl)->scrollbarHorizRef, portRect.right - 13,16);

    ShowControl((*docStrucHdl)->scrollbarVertRef);
    ShowControl((*docStrucHdl)->scrollbarHorizRef);

    SetControlMaximum((*docStrucHdl)->scrollbarVertRef,portRect.bottom - portRect.top - 25
        - kScrollBarWidth);
    SetControlMaximum((*docStrucHdl)->scrollbarHorizRef,portRect.right - portRect.left
        - kScrollBarWidth);
}

// ***** doDrawMessage

void doDrawMessage(WindowRef windowRef,Boolean inState)

```

```

{
    Rect      portRect, headerRect;
    CFStringRef stringRef;
    Rect      textBoxRect;

    if(windowRef == gWindowRef)
    {
        SetPortWindowPort(windowRef);

        GetWindowPortBounds(windowRef,&portRect);

        SetRect(&headerRect,portRect.left - 1,portRect.top - 1,portRect.right + 1,
                portRect.top + 26);
        DrawThemeWindowHeader(&headerRect,inState);

        if(inState == kThemeStateActive)
            TextMode(srcOr);
        else
            TextMode(grayishTextOr);

        stringRef = CFStringCreateWithPascalString(NULL,gCurrentString,
                                                    kCFStringEncodingMacRoman);
        SetRect(&textBoxRect,portRect.left,6,portRect.right,21);
        DrawThemeTextBox(stringRef,kThemeSmallSystemFont,0,true,&textBoxRect,teJustCenter,NULL);
        if(stringRef != NULL)
            CFRelease(stringRef);

        TextMode(srcOr);
    }
}

// ***** doConcatPStrings

void doConcatPStrings(Str255 targetString,Str255 appendString)
{
    SInt16 appendLength;

    appendLength = MIN(appendString[0],255 - targetString[0]);

    if(appendLength > 0)
    {
        BlockMoveData(appendString+1,targetString+targetString[0]+1,(SInt32) appendLength);
        targetString[0] += appendLength;
    }
}

// ***** doCopyPString

void doCopyPString(Str255 sourceString,Str255 destinationString)
{
    SInt16 stringLength;

    stringLength = sourceString[0];
    BlockMove(sourceString + 1,destinationString + 1,stringLength);
    destinationString[0] = stringLength;
}

```

```
// ***** helpTags

void helpTags(WindowRef windowRef)
{
    docStrucHandle docStrucHdl;
    HMHelpContentRec helpContent;

    memset(&helpContent,0,sizeof(helpContent));

    docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));

    HMSetTagDelay(500);
    HMSetHelpTagsDisplayed(true);
    helpContent.version = kMacHelpVersion;
    helpContent.tagSide = kHMOutsideTopCenterAligned;

    helpContent.content[kHMMMinimumContentIndex].contentType = kHMStringResContent;
    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmResID = 128;

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 1;
    HMSetControlHelpContent((*docStrucHdl)->popupFixedRef,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 2;
    HMSetControlHelpContent((*docStrucHdl)->popupVariableRef,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 3;
    HMSetControlHelpContent((*docStrucHdl)->popupWinFontRef,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 4;
    HMSetControlHelpContent((*docStrucHdl)->groupboxColorRef,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 5;
    HMSetControlHelpContent((*docStrucHdl)->groupboxGridsRef,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 6;
    HMSetControlHelpContent((*docStrucHdl)->buttonRef,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 7;
    HMSetControlHelpContent((*docStrucHdl)->buttonDefaultRef,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 8;
    HMSetControlHelpContent((*docStrucHdl)->buttonLeftIconRef,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 9;
    HMSetControlHelpContent((*docStrucHdl)->buttonRightIconRef,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 10;
    HMSetControlHelpContent((*docStrucHdl)->scrollbarVertRef,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 11;
    HMSetControlHelpContent((*docStrucHdl)->scrollbarHorizRef,&helpContent);
}

// *****
```

## Demonstration Program Controls1 Comments

When this program is run, the user should

- On Mac OS 8/9, choose Show Balloons from the Help menu and peruse the help balloons which are invoked when the mouse cursor is moved over the various controls.
- On Mac OS X, peruse the Help tags which are invoked when the mouse cursor is held over the various controls.
- Choose items from each of the pop-up menu buttons, noting that the chosen item is displayed in the window header.
- Click on the radio buttons, checkboxes, and push buttons, noting particularly that the radio button settings are mutually exclusive and that checkbox settings are not.
- Click in the scroll bar arrows and gray areas/tracks of the scroll bars, noting the control value changes displayed in the window header.
- Drag the scroll box/scroller of the vertical scroll bar (which uses the non-live-feedback CDEF variant), noting that only a ghosted outline is dragged and that the control value does not change until the mouse button is released.
- Drag the scroll box/scroller of the horizontal scroll bar (which uses the live-feedback CDEF variant), noting that the scroll box proper is dragged and that the control value is continually updated during the drag.
- Resize and zoom the window, noting that the scroll bars are moved and resized in response to those actions and the change in the maximum value of the scroll bars.
- Send the program to the background and bring it to the foreground, noting the changes to the appearance of the controls. (The program activates and deactivates the root control only; however, because all controls are embedded in the root control, all controls are activated and deactivated along with the root control.)
- Alternately hide and show the Color primary group box by choosing the associated item in the Demonstration menu. (The program hides and shows the primary group box only; however, because the radio buttons are embedded in the primary group box, those controls hidden and shown along with the primary group box.)
- Alternately activate and deactivate the Grids primary group box by choosing the associated item in the Demonstration menu. (The program activates and deactivates the primary group box only; however, because the checkboxes are embedded in the primary group box, those controls are activated and deactivated along with the primary group box.) Also note the latency of the Show Rulers checkbox. It is deactivated at program launch, and retains that status when the primary group box is deactivated and then re-activated.



In this program (and all others that use Help tags), the header file `string.h` is included and the library `MSL C.PPC.Lib` has been added to the project because of the use of `memset` in the function `helpTags`.

If you want to display the Help tags, rather than Balloon help, on Mac OS 8/9

- Comment out the line `"if(gRunningOnX)"` before the line `"helpTags(gWindowRef);"`.
- In the function `helpTags`, change `"kHMOutsideTopCenterAligned"` to `"kHMOutsideLeftCenterAligned"`. (At the time of writing, use of any but the first thirteen positioning constants in `MacHelp.h` defeated the display of Help tags on Mac OS 8/9.)

Help tag creation is addressed in Chapter 25.

## defines

Constants are established for 'CNTL' resources for those controls not created programmatically.

## typedef

The data type `docStruc` is a structure comprising fields in which the references to the control objects for the various controls will be stored. A handle to this structure will be stored in the window's window object.

## Global Variables

`actionFunctionVertUPP` and `actionFunctionHorizUPP` will be assigned universal procedure pointers to action functions for the scroll bars.

## main

Universal procedure pointers are created for the action functions for the two scroll bars.

The call to the function `copyPString` causes the string in the first parameter to be copied to the global variable `gCurrentString`. The string in `gCurrentString`, which will be changed at various points in the code, will be drawn in the window header frame.

The next block opens a window, makes the window's graphics port the current port, and sets the graphics port's font to the small system font. This latter is because one of the pop-up menus will use the window font. `SetThemeWindowBackground` is called to set the background color/pattern for the window. The window's background will be similar to that applying to Mac OS 8/9 dialogs, which is appropriate for a window containing nothing but controls.

The call to `NewHandle` gets a relocatable block the size of one `docStruc` structure. The handle to the block is stored in the window's window object by the call to `SetWRefCon`.

In the next block, `doGetControls` creates and draws the controls, `doAdjustScrollBars` resizes and locates the scroll bars, and sets their maximum value, according to the dimensions of the window's port rectangle, and `ShowWindow` makes the window visible.

Note that error handling here and in other areas of this demonstration program is somewhat rudimentary. In the unlikely event that certain calls fail, `ExitToShell` is called to terminate the program.

### **doGetControls**

The function `doGetControls` creates the controls.

At the first line, if the program is running on Mac OS 8/9, `CreateRootControl` is called to create a root control for the window. On Mac OS 8/9, the first control created must be always be the root control (which is implemented as a user pane). This call is not necessary on Mac OS X because, on Mac OS X, root controls are created automatically for windows which have at least one control.

A handle to the structure in which the references to the control objects will be stored is then retrieved.

The controls are then created, some from 'CNTL' resources using `GetNewControl` and some programmatically. All of these calls create a control object for the relevant control and insert the object into the control list for the specified window. `GetNewControl` draws the controls created from 'CNTL' resources. In the case of controls created programmatically, `ShowControl` must be called to cause the control to be drawn. The reference to each control object is assigned to the appropriate field of the window's "document" structure.

Because of the sequence in which the controls are created and initially drawn, the group boxes would ordinarily over-draw the radio buttons and checkboxes. However, the calls to `AutoEmbedControl` embed these latter controls in their respective group boxes, ensuring that they will be drawn after (or "on top of") the group boxes. (`AutoEmbedControl`, rather than `EmbedControl`, is used in this instance because the radio button rectangles are visually contained by their respective group box rectangles.)

The call to `SetControlData`, with `kControlPushButtonDefaultTag` passed in the third parameter, causes the default outline to be drawn around the specified push button.

In the next block, the title fonts of the left color icon variant and right color icon variant push buttons are changed. Firstly, the flags and font fields of a control font style structure are assigned constants so that the following call to `SetControlFontStyle` will set the title font of the left color icon variant push button to the small system font. The font field is then changed so that the second call to `SetControlFontStyle` will set the title font of the right color icon variant push button to the small emphasized system font.

Lastly, the checkbox titled Rulers is disabled. This is for the purpose of the latency aspect of the demonstration.

### **doMouseDown**

`doMouseDown` switches according to the window part in which a `mouseDown` event occurs.

At the `inContent` case, if the window in which the mouse-down occurred is the front window, and since all of the controls are located in the window's content region, a call to the function `doInContent` is made.

The `inGrow` case is of particular significance to the scroll bars. Following the call to `ResizeWindow`, the function `doAdjustScrollBars` is called to erase, move, resize, and redraw the scroll bars and reset the control's maximum value according to the new size of the window. (The call to `doDrawMessage` is incidental to the demonstration. It simply redraws the window header frame and text in the window.)

The `inZoomIn/InZoomOut` case is also of significance to the scroll bars. If the call to `TrackBox` returns a non-zero value, the window's port rectangle is erased before `ZoomWindowIdeal` zooms the window. Following the call to `ZoomWindowIdeal` the function `doAdjustScrollBars` is called to hide, move, resize, and redraw the scroll bars.

### **doMenuChoice**

`doMenuChoice` handles user choices from the pull-down menus.

The `mDemonstration` case handles the Demonstration menu. Reference to that menu and a handle to the window's "document" structure are obtained.

If the menu item is the Color item, `IsControlVisible` is called to determine the current visibility status of the Color group box. If it is visible, the call to `HideControl` hides the group box and its embedded radio buttons; also, the menu item text is changed to "Show Color." If it is not visible, `ShowControl` is called and the menu item text is changed to "Hide Color."

If the menu item is the Grids item, the same general sequence takes place in respect of the Grids group box. This time, however, `IsControlActive` is used to determine whether the control is active or inactive, and `ActivateControl` and `DeactivateControl` are called, and the menu item is toggled, as appropriate. Note that, because of latency, the application does not have to "remember" that one of the embedded checkboxes was deactivated at program start. The Control Manager does the remembering.

### **doUpdate**

`doUpdate` is called whenever the application receives an update event for its window. Between the usual calls to `BeginUpdate` and `EndUpdate` (ignored on Mac OS X), the window's graphics port is set as the current port for drawing, and `UpdateControls` is called to draw those controls intersecting the current visible region (which, between the `BeginUpdate` and `EndUpdate` calls, equates to the Mac OS 8/9 update region). The line preceding the if block is incidental to the demonstration. It simply redraws the window header frame and text in the window.

### **doActivateWindow**

`doActivateWindow` switches according to whether the specified window is becoming active or is about to be made inactive. (Actually, `doActivateWindow` will never be called by `doActivate` in this program because the program only opens one window. It will however, be called by the function `doOSEvent`.)

At the first line, `GetRootControl` gets a reference to the window's root control.

If the window is becoming active, `ActivateControl` is called to activate the root control. Since all other controls are embedded in the root control, all controls will be activated by this call.

If the window is about to become inactive, `DeactivateControl` is called to deactivate the root control. Since all other controls are embedded in the root control, all controls will be deactivated by this call.

The calls to `doDrawMessage` are incidental to the demonstration. They simply redraw the window header frame and text in the window in the appropriate mode (inactive or active).

### **doOSEvent**

`doOSEvent` handles operating system events. If the event is a suspend or resume event, a global variable is then set to indicate whether the program has come to the foreground or has been sent to the background. This global variable is used in `doUpdate`, and controls the color in which the text in the window header is drawn.

### **doInContent**

`doInContent` further processes mouse-down events in the content region. Because the content region of the window contains nothing but controls, this function is really just the main switching point for the further handling of those controls.

The first line gets the handle to the "document" structure containing the references to the various control objects. The call to `SetPortWindowPort` is a necessary precursor to the call to `GlobalToLocal`, which converts the mouse coordinates in the event structure's `where` field from global coordinates to the local coordinates required in the following call to `FindControl`. (`FindControl` is used here rather than the newer function `FindControlUnderMouse` because there is no requirement to get a reference to a control even if no part was hit and no requirement to determine whether a mouse-down event has occurred in a deactivated control.)

If there is a control at the cursor location at which the mouse button is released, the control reference returned by the `FindControl` call is first compared with the references to the pop-up menu controls stored in the window's "document" structure. If a match is found, `TrackControl` is called with `(ControlActionUPP) -1` passed in the `actionProc` parameter so as to cause an action function within the control's CDEF to be repeatedly invoked while the mouse button remains down. When `TrackControl` returns, the control value is obtained by a call to `GetControlValue` and a function is called to perform further handling

Note that `TrackControl`, rather than the newer function `HandleControlClick`, is used in this program because none of the controls require modifier keys to be passed in. (Of course, `HandleControlClick` would work just as well (with 0 passed in the `inModifiers` parameter).)

If the control reference returned by `FindControl` does not match the pop-up controls' references, it is then tested against the references to the vertical and horizontal scroll bar controls. If it matches the reference to the vertical scroll bar (which uses the non-live-feedback CDEF variant), the function `doVertScrollbar` is called to perform further handling. If it matches the reference to the horizontal scroll bar (which uses the live-feedback CDEF variant), `TrackControl` is called (`ControlActionUPP` -1 passed in the `actionProc` parameter. This latter is because the UPP to the control action function has already been set. (Recall that it was passed in a parameter of the `CreateScrollbarControl` call which created the control.) The net effect of is that the application-defined action function to which the UPP relates will be repeatedly called while the mouse button remains down.

If the reference returned by `FindControl` does not match the references to any of the pop-up menu buttons or scroll bars, it must be a reference to one of the other controls. In this case, `TrackControl` is called, with the `procPtr` field set to that required for push buttons, radio buttons, and checkboxes (that is, `NULL`). If the cursor is still within the control when the mouse button is released, the reference is compared to, in sequence, the references to the radio buttons, the checkboxes, and the push buttons. If a match is found, the appropriate function is called to perform further handling.

### **doPopupMenuChoice**

`doPopupMenuChoice` further handles mouse-downs in the pop-up menu buttons. In this demonstration, the further handling that would normally take place here is replaced by simply drawing the menu item text in the window.

The call to `GetControlData` gets a reference to the control's menu, allowing `GetMenuItemText` to get the item text into a global variable. This allows the text to be drawn in the window header frame.

### **doVertScrollbar**

`doVertScrollbar` is called from `doInContent` in the case of a mouse-down in the vertical scroll bar (which uses the non-live-feedback variant of the CDEF).

The call to `copyPString` is incidental to the demonstration. It simply copies some appropriate text to the global variable `gCurrentString`.

At the next line, the function switches on the control part code. If the control part code was the scroll box/scroller (that is, the "indicator"), `TrackControl` is called with the `procPtr` parameter set to that required for the scroll box of non-live-feedback scroll bars (that is, `NULL`). If the user did not move the cursor outside the control before releasing it, the `if` block executes,

retrieving the new control value, converting it to a string, appending that string to the string currently in `gCurrentString`, and drawing `gCurrentString` in the window header. (In a real application, calculation of the distance and direction to scroll, and the scrolling itself, would take place inside this `if` block.)

If the mouse down was in the gray area/track or one of the scroll arrows, `TrackControl` is called with a Universal Procedure Pointer (UPP) passed in the `actionProc` parameter. The effect of this is that the application-defined action function to which the UPP relates will be repeatedly called while the mouse button remains down.

### Action Functions

An action function is an example of a “callback function” (sometimes called a “hook function”). A callback function is an application-defined function that is called by a Toolbox function during the Toolbox function’s execution, thus extending the features of the Toolbox function.

#### **actionFunctionVert**

`actionFunctionVert` is the action function called by `TrackControl` at the bottom of `doVertScrollbar`. Because it is repeatedly called by `TrackControl` while the mouse button remains down, the scrolling such a function would perform in a real application continues repeatedly until the mouse button is released (provided the cursor remains within the scroll arrow or gray area/track).

The call to `copyPString` is incidental to the demonstration. It simply copies some appropriate text to the global variable `gCurrentString`.

The `if(controlPartCode)` line ensures that, if the cursor is not still inside the scroll arrow or gray area/track, the action function exits and all scrolling ceases until the user brings the cursor back within the scroll arrow or gray area/track, causing a non-zero control part code to be again received. The following occurs only when the cursor is within the control.

The function switches on the control part code. If the mouse-down is in a scroll arrow, the variable `scrollDistance` is set to 2. If it is in a gray area, `scrollDistance` is set to 55. (In this simple demonstration, these are just arbitrary values. In a real application, you would assign an appropriate value in the case of the scroll arrows, and assign a calculated value (based primarily on current window height) in the case of the gray areas/tracks.)

The next block converts the value in `scrollDistance` to the required negative value if the user is scrolling down rather than up.



The next block defeats any further scrolling action if the down scroll arrow is being used and the “document” is at the maximum scrolled position or the up scroll arrow is being used and the “document” is at the minimum scrolled position.

The distance to scroll having been set, the call to the function `doMoveScrollBar` moves the scroll box/scroller the appropriate distance in the appropriate direction and updates the control’s value accordingly. This means, of course, that the scroll box/scroller is being continually moved, and the control’s value continually updated, while the mouse button remains down.

In this demonstration, the remaining action is to retrieve the current value of the control, convert it to a string, append it to the string currently in `gCurrentString`, and draw `gCurrentString` in the window header frame. (In a real application, the actual scrolling of the window’s contents would be affected here.)

### **actionFunctionHoriz**

`actionFunctionHoriz` is the action function passed in the `actionProc` parameter of the `TrackControl` call in `doInContent` arising from a mouse-down in the horizontal scroll bar. This action function differs from that for the vertical scroll bar because the horizontal scroll bar uses the live-feedback variant of the CDEF.

The principal differences are that action functions for live-feedback scroll bars must continually scroll the window’s contents, not only while the mouse button remains down in the scroll arrows and gray areas, but also while the scroll box/scroller is being dragged. Accordingly, this function, unlike the action function for the vertical scroll bar, is also called while the mouse button remains down in the scroll box/scroller.

The call to `copyPString` is incidental to the demonstration. It simply copies some appropriate text to the global variable `gCurrentString`.

If the mouse-down occurred in the scroll box/scroller, the code which sets up the scroll distance, adjusts the sign of the scroll distance according to whether the scroll is left or right, prevents scrolling beyond the minimum and maximum scroll values, and calls `doMoveScrollBar` to move the scroll box/scroller and update the control’s value, is bypassed. The call to `doMoveScrollBar` is bypassed because, in live-feedback, the CDEF moves the scroll box/scroller and updates the control’s value when the mouse-down is in the scroll box/scroller.

In this demonstration, the action taken after the main block of code has been bypassed (mouse-down in the scroll box/scroller) or executed (mouse-down in the scroll arrows or gray area/track) is to retrieve the current value of the control, convert it to a string, append it to the string currently in `gCurrentString`, and draw `gCurrentString` in the window header frame. (In a real application, the actual scrolling of the window’s contents would be affected here.)



### **doMoveScrollBar**

`doMoveScrollBar` is called from within the action functions to reset the control's current value to reflect the scrolled distance, and to reposition the scroll box/scroller accordingly.

The first two lines retrieve the control's current value and maximum value. The next line calculates the new control value by subtracting the distance to scroll received from the calling action function from the current control value. The next four lines prevent the control's value from being set lower or higher than the control's minimum and maximum values respectively. The call to `SetControlValue` sets the new control value and repositions the scroll box/scroller.

### **doRadioButtons**

`doRadioButtons` is called when the mouse-down is within a radio button. The first three calls to `SetControlValue` set all radio buttons to the off state. The final call sets the radio button under the mouse to the on state.

### **doCheckboxes**

`doCheckboxes` is called when the mouse-down is within a checkbox. The single line simply toggles the current value of the control.

### **doPushButtons**

`doPushButtons` is called when the mouse-down is within a push button. In this demonstration, the only action taken is to draw the identity of the push button in the window header frame.

### **doAdjustScrollBars**

`doAdjustScrollBar` is called if the user resizes or zooms the window.

At the first line, a handle to the window's "document" structure is retrieved from the window object.

At the next line, the coordinates representing the window's current content region are assigned to a `Rect` variable which will be used in calls to `MoveControl` and `SizeControl`.

`MoveControl` and `SizeControl` both redraw the specified scroll bar. Because `SizeControl` will be called immediately after `MoveControl`, this will cause a very slight flickering of the scroll bars. To prevent this, the scroll bars will be hidden while these two functions are executing.

The calls to `HideControl` hide the scroll bars. The calls to `MoveControl` erase the scroll bars, offset the `controlRect` fields of their control structures, and redraw the scroll bars within the offset rectangle. `SizeControl` hides the scroll bars (in this program they are already hidden), adjusts the `controlRect` fields of their control structures, and redraws the scroll bars within their new rectangles. The calls to `ShowControl` then show the scroll bars.

In this demonstration, the remaining lines set the new maximum values for the scroll bars according to the new height and width of the window. No attempt is made to calculate the

required new control value to ensure that the (non-existent) document remains in the same scrolled position after the zoom or resize. In a real application, this, plus the calculation of the maximum value according to, for example, the line height of text content as well as the new window height, are matters that would need to be attended to in this function.

## Demonstration Program Controls2 Listing

```
// *****
// Controls2.c                                     CLASSIC EVENT MODEL
// *****
//
// This program:
//
// • Opens a kWindowDocumentProc window with a two horizontal scroll bars, each of which
//   relates to the picture displayed immediately above it.
//
// • Allows the user to horizontally scroll the pictures within the window using the scroll
//   box/scroller, the scroll arrows and the gray area/track of each scroll bar.
//
// The top scroll bar uses the non-live-feedback variant of the scroll bar CDEF. The bottom
// scroll bar uses the live-feedback variant.
//
// With regard to the scroll bars, the principal differences between this program and
// Controls1 are that, in this program:
//
// • The scroll bar scroll boxes are made proportional.
//
// • The action functions are set using the function SetControlAction.
//
// • References to the scroll bar controls are not stored in, and retrieved from, a document
//   structure associated with the window. Instead, each control is assigned a controlID
//   using SetControlID, allowing the ID of the control to be retrieved using GetControlID
//   and a reference to the control to be obtained using GetControlByID.
//
// The program utilises the following resources:
//
// • A 'plst' resource.
//
// • An 'MBAR' resource, and 'MENU' resources for Apple, File and Edit (preload, non-
//   purgeable).
//
// • A 'WIND' resource (purgeable) (initially visible).
//
// • Two 'CNTL' resource for the horizontal scroll bars (purgeable).
//
// • 'PICT' resources containing the pictures to be scrolled (non-purgeable).
//
// • A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****
```

```

// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenuBar          128
#define rNewWindow        128
#define rPictureNonLive   128
#define rPictureLive      129
#define mAppleApplication 128
#define iAbout            1
#define mFile             129
#define iQuit             12
#define cScrollbarNonLive 128
#define cScrollbarLive    129
#define kScrollbarNonLiveID 1
#define kScrollbarLiveID  2
#define MAX_UINT32        0xFFFFFFFF

// ..... global variables

ControlActionUPP gActionFuncNonLiveUPP;
ControlActionUPP gActionFuncLiveUPP;
Boolean          gDone;
Rect             gPictRectNonLive, gPictRectLive;
PicHandle        gPictHandleNonLive, gPictHandleLive ;

// ..... function prototypes

void main                (void);
void doPreliminaries     (void);
OSErr quitAppEventHandler (AppleEvent *,AppleEvent *,SInt32);
void doEvents            (EventRecord *);
void doMouseDown         (EventRecord *);
void doUpdate            (EventRecord *);
void doActivate          (EventRecord *);
void doActivateWindow    (WindowRef,Boolean);
void doOSEvent           (EventRecord *);
void doMenuChoice        (SInt32);
void doInContent         (EventRecord *,WindowRef);
void doNonLiveScrollBars (ControlPartCode,WindowRef,ControlRef,Point);
void actionFuncNonLive   (ControlRef,ControlPartCode);
void actionFuncLive      (ControlRef,ControlPartCode);
void doMoveScrollBar     (ControlRef,SInt16);

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;
    MenuRef        menuRef;
    WindowRef      windowRef;

```

```

ControlRef    controlRefScrollbarNonLive, controlRefScrollbarLive;
ControlID     controlID;
Rect          portRect;
EventRecord   eventStructure;

// ..... do preliminaries

doPreliminaries();

// ..... create universal procedure pointers

gActionFuncNonLiveUPP = NewControlActionUPP((ControlActionProcPtr) actionFuncNonLive);
gActionFuncLiveUPP    = NewControlActionUPP((ControlActionProcPtr) actionFuncLive);

// ..... set up menu bar and menus

menubarHdl = GetNewMBar(rMenuBar);
if(menubarHdl == NULL)
    ExitToShell();
SetMenuBar(menubarHdl);
DrawMenuBar();

Gestalt(gestaltMenuMgrAttr,&response);
if(response & gestaltMenuMgrAquaLayoutMask)
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
    {
        DeleteMenuItem(menuRef,iQuit);
        DeleteMenuItem(menuRef,iQuit - 1);
        DisableMenuItem(menuRef,0);
    }
}

// ..... open a window

if(!(windowRef = GetNewCWindow(rNewWindow,NULL,(WindowRef)-1)))
    ExitToShell();

SetPortWindowPort(windowRef);

// ..... get controls and set ID and control action functions

controlRefScrollbarNonLive = GetNewControl(cScrollbarNonLive,windowRef);
controlID.signature = 'kjb ';
controlID.id = kScrollbarNonLiveID;
SetControlID(controlRefScrollbarNonLive,&controlID);

SetControlAction(controlRefScrollbarNonLive,gActionFuncNonLiveUPP);

controlRefScrollbarLive = GetNewControl(cScrollbarLive,windowRef);
controlID.id = kScrollbarLiveID;
SetControlID(controlRefScrollbarLive,&controlID);

SetControlAction(controlRefScrollbarLive,gActionFuncLiveUPP);

```

```

// ..... get picture

if(!(gPictHandleNonLive = GetPicture(rPictureNonLive)))
    ExitToShell();
gPictRectNonLive = (*gPictHandleNonLive)->picFrame;

if(!(gPictHandleLive = GetPicture(rPictureLive)))
    ExitToShell();
gPictRectLive = (*gPictHandleLive)->picFrame;
OffsetRect(&gPictRectLive,0,191);

// ..... set up for proportional scroll boxes

GetWindowPortBounds(windowRef,&portRect);
SetControlViewSize(controlRefScrollbarNonLive,portRect.right);
SetControlViewSize(controlRefScrollbarLive,portRect.right);

// ..... enter eventLoop

gDone = false;

while(!gDone)
{
    if(WaitNextEvent(everyEvent,&eventStructure,MAX_UINT32,NULL))
        doEvents(&eventStructure);
}
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    OSErr osError;

    MoreMasterPointers(32);
    InitCursor();
    FlushEvents(everyEvent,0);

    osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
                                   NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
                                   0L,false);

    if(osError != noErr)
        ExitToShell();
}

// ***** doQuitAppEvent

OSErr quitAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,SInt32 handlerRefcon)
{
    OSErr osError;
    DescType returnedType;
    Size actualSize;

```

```

osError = AEGetAttributePtr(appEvent,keyMissedKeywordAttr,typeWildCard,&returnedType,NULL,0,
                           &actualSize);

if(osError == errAEDescNotFound)
{
    gDone = true;
    osError = noErr;
}
else if(osError == noErr)
    osError = errAEParamMissed;

return osError;
}

// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEProcessAppleEvent(eventStrucPtr);
            break;

        case mouseDown:
            doMouseDown(eventStrucPtr);
            break;

        case updateEvt:
            doUpdate(eventStrucPtr);
            break;

        case activateEvt:
            doActivate(eventStrucPtr);
            break;

        case osEvt:
            doOSEvent(eventStrucPtr);
            break;
    }
}

// ***** doMouseDown

void doMouseDown(EventRecord *eventStrucPtr)
{
    WindowRef      windowRef;
    WindowPartCode partCode;

    partCode = FindWindow(eventStrucPtr->where,&windowRef);

    switch(partCode)

```

```

{
    case inMenuBar:
        doMenuChoice(MenuSelect(eventStrucPtr->where));
        break;

    case inContent:
        if(windowRef != FrontWindow())
            SelectWindow(windowRef);
        else
            doInContent(eventStrucPtr,windowRef);
        break;

    case inDrag:
        DragWindow(windowRef,eventStrucPtr->where,NULL);
        break;
}
}

// ***** doUpdate

void doUpdate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    RgnHandle regionHdl;
    ControlID controlID;
    ControlRef controlRef;

    windowRef = (WindowRef) eventStrucPtr->message;

    BeginUpdate(windowRef);

    SetPortWindowPort(windowRef);

    regionHdl = NewRgn();
    if(regionHdl)
    {
        GetPortVisibleRegion(GetWindowPort(windowRef),regionHdl);
        UpdateControls(windowRef,regionHdl);
        DisposeRgn(regionHdl);
    }

    controlID.signature = 'kjb ';
    controlID.id = kScrollbarNonLiveID;
    GetControlByID(windowRef,&controlID,&controlRef);
    SetOrigin(GetControlValue(controlRef),0);
    DrawPicture(gPictHandleNonLive,&gPictRectNonLive);
    SetOrigin(0,0);

    controlID.id = kScrollbarLiveID;
    GetControlByID(windowRef,&controlID,&controlRef);
    SetOrigin(GetControlValue(controlRef),0);
    DrawPicture(gPictHandleLive,&gPictRectLive);
    SetOrigin(0,0);
}

```



```

    EndUpdate(windowRef);
}

// ***** doActivate

void doActivate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    Boolean    becomingActive;

    windowRef = (WindowRef) eventStrucPtr->message;
    becomingActive = ((eventStrucPtr->modifiers & activeFlag) == activeFlag);
    doActivateWindow(windowRef, becomingActive);
}

// ***** doActivateWindow

void doActivateWindow(WindowRef windowRef, Boolean becomingActive)
{
    ControlID controlID;
    ControlRef controlRefScrollbarNonLive, controlRefScrollbarLive;

    controlID.signature = 'kjb ';
    controlID.id = kScrollbarNonLiveID;
    GetControlByID(windowRef, &controlID, &controlRefScrollbarNonLive);
    controlID.id = kScrollbarLiveID;
    GetControlByID(windowRef, &controlID, &controlRefScrollbarLive);

    if(becomingActive)
    {
        ActivateControl(controlRefScrollbarNonLive);
        ActivateControl(controlRefScrollbarLive);
    }
    else
    {
        DeactivateControl(controlRefScrollbarNonLive);
        DeactivateControl(controlRefScrollbarLive);
    }
}

// ***** doOSEvent

void doOSEvent(EventRecord *eventStrucPtr)
{
    switch((eventStrucPtr->message >> 24) & 0x000000FF)
    {
        case suspendResumeMessage:
            if((eventStrucPtr->message & resumeFlag) == 1)
                SetThemeCursor(kThemeArrowCursor);
            break;
    }
}

```

```

// ***** doMenuChoice

void doMenuChoice(SInt32 menuChoice)
{
    MenuID      menuID;
    MenuItemIndex menuItem;

    menuID = HiWord(menuChoice);
    menuItem = LoWord(menuChoice);

    if(menuID == 0)
        return;

    switch(menuID)
    {
        case mAppleApplication:
            if(menuItem == iAbout)
                SysBeep(10);
            break;

        case mFile:
            if(menuItem == iQuit)
                gDone = true;
            break;
    }

    HiliteMenu(0);
}

// ***** doInContent

void doInContent(EventRecord *eventStrucPtr, WindowRef windowRef)
{
    ControlPartCode controlPartCode;
    ControlRef      controlRef;
    ControlID       controlID;

    SetPortWindowPort(windowRef);
    GlobalToLocal(&eventStrucPtr->where);

    if(controlPartCode = FindControl(eventStrucPtr->where, windowRef, &controlRef))
    {
        GetControlID(controlRef, &controlID);

        if(controlID.id == kScrollbarNonLiveID)
            doNonLiveScrollBars(controlPartCode, windowRef, controlRef, eventStrucPtr->where);
        else if(controlID.id == kScrollbarLiveID)
            TrackControl(controlRef, eventStrucPtr->where, (ControlActionUPP) -1);
    }
}

```

```
// ***** doNonLiveScrollBars

void doNonLiveScrollBars(ControlPartCode controlPartCode, WindowRef windowRef,
                        ControlRef controlRef, Point mouseXY)
{
    SInt16    oldControlValue;
    SInt16    scrollDistance;
    RgnHandle updateRgnHdl;

    switch(controlPartCode)
    {
        case kControlIndicatorPart:
            oldControlValue = GetControlValue(controlRef);
            if(TrackControl(controlRef, mouseXY, NULL))
            {
                scrollDistance = oldControlValue - GetControlValue(controlRef);
                if(scrollDistance != 0)
                {
                    updateRgnHdl = NewRgn();
                    ScrollRect(&gPictRectNonLive, scrollDistance, 0, updateRgnHdl);
                    InvalWindowRgn(windowRef, updateRgnHdl);
                    DisposeRgn(updateRgnHdl);
                }
            }
            break;

        case kControlUpButtonPart:
        case kControlDownButtonPart:
        case kControlPageUpPart:
        case kControlPageDownPart:
            TrackControl(controlRef, mouseXY, (ControlActionUPP) -1);
            break;
    }
}

// ***** actionFuncNonLive

void actionFuncNonLive(ControlRef controlRef, ControlPartCode controlPartCode)
{
    WindowRef windowRef;
    SInt16    scrollDistance, controlValue;
    Rect      portRect;
    RgnHandle updateRgnHdl;

    if(controlPartCode)
    {
        windowRef = GetControlOwner(controlRef);

        switch(controlPartCode)
        {
            case kControlUpButtonPart:
            case kControlDownButtonPart:
                scrollDistance = 2;
                break;
        }
    }
}
```

```

        case kControlPageUpPart:
        case kControlPageDownPart:
            GetWindowPortBounds(windowRef,&portRect);
            scrollDistance = (portRect.right - portRect.left - 10);
            break;
    }

    if((controlPartCode == kControlDownButtonPart) ||
        (controlPartCode == kControlPageDownPart))
        scrollDistance = -scrollDistance;

    controlValue = GetControlValue(controlRef);
    if(((controlValue == GetControlMaximum(controlRef)) && scrollDistance < 0) ||
        ((controlValue == GetControlMinimum(controlRef)) && scrollDistance > 0))
        return;

    doMoveScrollBar(controlRef,scrollDistance);

    if(controlPartCode == kControlUpButtonPart ||
        controlPartCode == kControlDownButtonPart)
    {
        updateRgnHdl = NewRgn();
        ScrollRect(&gPictRectNonLive,scrollDistance,0,updateRgnHdl);
        InvalWindowRgn(windowRef,updateRgnHdl);
        DisposeRgn(updateRgnHdl);
        BeginUpdate(windowRef);
    }

    SetOrigin(GetControlValue(controlRef),0);
    DrawPicture(gPictHandleNonLive,&gPictRectNonLive);
    SetOrigin(0,0);

    if(controlPartCode == kControlUpButtonPart || controlPartCode == kControlDownButtonPart)
        EndUpdate(windowRef);
    }
}

// ***** actionFuncLive

void actionFuncLive(ControlRef controlRef,ControlPartCode partCode)
{
    WindowRef windowRef;
    SInt16 scrollDistance, controlValue;
    Rect portRect;

    windowRef = GetControlOwner(controlRef);

    if(partCode != 0)
    {
        if(partCode != kControlIndicatorPart)
        {
            switch(partCode)

```

```

{
    case kControlUpButtonPart:
    case kControlDownButtonPart:
        scrollDistance = 2;
        break;

    case kControlPageUpPart:
    case kControlPageDownPart:
        GetWindowPortBounds(windowRef,&portRect);
        scrollDistance = (portRect.right - portRect.left) - 10;
        break;
}

if((partCode == kControlDownButtonPart) || (partCode == kControlPageDownPart))
    scrollDistance = -scrollDistance;

controlValue = GetControlValue(controlRef);
if(((controlValue == GetControlMaximum(controlRef)) && scrollDistance < 0) ||
    ((controlValue == GetControlMinimum(controlRef)) && scrollDistance > 0))
    return;

doMoveScrollBar(controlRef,scrollDistance);
}

SetOrigin(GetControlValue(controlRef),0);
DrawPicture(gPictHandleLive,&gPictRectLive);
SetOrigin(0,0);
}
}

// ***** doMoveScrollBar

void doMoveScrollBar(ControlRef controlRef,SInt16 scrollDistance)
{
    SInt16 oldControlValue, controlValue, controlMax;

    oldControlValue = GetControlValue(controlRef);
    controlMax = GetControlMaximum(controlRef);

    controlValue = oldControlValue - scrollDistance;

    if(controlValue < 0)
        controlValue = 0;
    else if(controlValue > controlMax)
        controlValue = controlMax;

    SetControlValue(controlRef,controlValue);
}

// *****

```

## Demonstration Program Controls2 Comments

This program is basically an extension of the scroll bars' aspects of the demonstration program Controls1 in that, unlike the scroll bars in Controls1, the scroll bars in this program actually scroll the contents of the window. Also, this program supports proportional scroll boxes/scrollers.

When the program is run, the user should scroll the pictures by dragging the scroll boxes/scrollers, clicking in the scroll bar gray areas/tracks, clicking in the scroll arrows and holding the mouse button down while the cursor is in the gray areas/tracks and scroll arrows. The user should note, when scrolling with the scroll boxes/scrollers, that the top scroll bar uses the non-live-feedback variant of the scroll bar CDEF and the bottom scroll bar uses the live-feedback variant, this latter to facilitate the program's live-scrolling of the bottom picture.

The pictures scrolled in this demonstration are, respectively 1220 by 175 pixels and 915 by 175 pixels. "pane" for each picture and scroll bar is 400 pixels wide by 175 pixels high, the 'CNTL' resources set the control maximum values to 820 and 515 respectively, and the control rectangles specified in the 'CNTL' resource locate the scroll bars in the correct position in the non-resizable, non-zoomable window.

As an incidental aspect of the demonstration, two different methods are used to scroll the pictures when the scroll arrows are being used. In the top picture, at each pass through the action function, the pixels are scrolled using ScrollRect, the "vacated" area is invalidated, and only this vacated area is redrawn. In the bottom picture, at each pass through the action function, the whole visible part of the picture is redrawn. The user should note that the first method results in some flickering in the "vacated" area when the picture is scrolled, and that the second method eliminates this flickering at the cost of some horizontal "tearing" of the picture caused by the way in which the image is drawn by the monitor on its screen.

The following comments are limited to those areas which are significantly different from the same areas in the demonstration program Controls1.

### **defines**

kScrollbarNonLiveID and kScrollbarLiveID will be assigned as the IDs of, respectively, the top (non-live) scroll bar and the bottom (live) scroll bar.

### **main**

Two calls to GetNewControl allocate memory for the control objects, insert the control objects into the window's control list and draw the controls.

Following each call to `GetNewControl`

- The `id` field of a variable of type `ControlID` is assigned the appropriate ID value for the specific control and the ID is then assigned to the control by a call to `SetControlID`.
- `SetControlAction` is called with a UPP passed in the `actionProc` parameter. The effect of this is that the application-defined action function to which the UPP relates will be repeatedly called while the mouse button remains down. As a consequence of using `SetControlAction`, `(ControlActionUPP) -1` will be passed in `TrackControl`'s `actionProc` parameter.

Note that no root control is created in this program; accordingly, the two controls will be activated and deactivated individually.

In the next block, two 'PICT' resources are loaded, the associated handles being assigned to two global variables. In each case, the picture structure's `picFrame` field (a `Rect`) is copied to a global variable. In the case of the second picture, this rectangle is then offset downwards by 191 pixels. (Note that the two 'PICT' resources were created so that the top and left fields of the `picFrame Rect` are both zero.)

In the next block, the width of the port rectangle is passed in the `newViewSize` parameter of calls to `SetControlViewSize`. (In this case, the view width is the same as the width of the port rectangle. This value is in the same units of measurement as are used for the scroll bar minimum, maximum, and current values.) This makes the scroll boxes proportional (on Mac OS 8/9, provided that the user has selected Smart Scrolling on in the Options tab of the Appearance control panel).

### **doUpdate**

In the two blocks which draw the pictures, the first call to `SetOrigin` sets the window origin to the current scroll position, that is, to the position represented by the control's current value, thus ensuring that the correct part of the picture will be drawn by the call to `DrawPicture`. The second call to `SetOrigin` resets the window's origin to (0,0).

Note that `GetControlByID` is used to retrieve references to the two controls.

### **DoActivateWindow**

Note that `GetControlByID` is used to retrieve references to the two controls.

### **doInContent**

`doInContent` establishes whether a mouse-down event was in one of the scroll bars and, if so, branches accordingly.

The call to `GlobalToLocal` converts the global coordinates of the mouse-down, stored in the `where` field of the event structure, to the local coordinates required by `FindControl`. If the call to `FindControl` returns a non-zero result, the mouse-down was in a scroll bar.



If the mouse-down was in a scroll bar, `GetControlID` is called to get the ID of the control. Then, as in the demonstration program `Controls1`

- If the mouse-down was in the non-live-feedback scroll bar, one of the application's functions is called to further handle the mouse-down event.
- If the mouse-down was in the live-feedback scroll bar, `TrackControl` is called with `(ControlActionUPP) -1` passed in the `actionProc` parameter. This means that the application-defined (callback) function associated with the UPP previously set by `SetControlAction` will be continually called while the mouse button remains down.

### **doNonLiveScrollBars**

`doNonLiveScrollBars` is similar to its sister function in `Controls1` except that it actually scrolls the window's contents.

At the first line, the function switches on the control part code:

- If the mouse-down was in the scroll box/scroller (that is, the “indicator”), the control's value at the time of the mouse-down is retrieved. Control is then handed over to `TrackControl`, which tracks user actions while the mouse button remains down. If the user releases the mouse button with the cursor inside the scroll box/scroller, the scroll distance (in pixels) is calculated by subtracting the control's value prior to the scroll from its current value. If the user moved the scroll box/scroller, the picture's pixels are scrolled by the specified scroll distance in the appropriate direction, and the “vacated” area of the window following the scroll is added to the (currently empty) window update region (Mac OS 8/9). This means that an update event will be generated for the window and that the redraw of the picture will be attended to in the `doUpdate` function.
- If the mouse-down was in a scroll arrow or gray area/track, more specifically in one of the non-live-feedback's scroll bar's scroll arrows or gray areas/tracks, `TrackControl` takes control until the user releases the mouse button. The third parameter in the `TrackControl` call means that the application-defined (callback) function associated with the UPP set by `SetControlAction` will be continually called while the mouse button remains down.

### **actionFunctionNonLive**

`actionFunctionNonLive` is the action function for the non-live-feedback scroll bar. Because it is repeatedly called by `TrackControl` while the mouse button remains down, the scrolling it performs continues repeatedly until the mouse button is released.

If the cursor is not still inside the scroll arrow or gray area/track, the action function exits. The following occurs only when the cursor is within the control.

A reference to the window which “owns” this control is retrieved from the control object.

If the control part being used by the user to perform the scrolling is one of the scroll arrows, the distance to scroll (in pixels) is set to 2. If the control part being used is one of the gray areas/track, the distance to scroll is set to the width of the window's content region minus 10 pixels. (Subtracting 10 pixels ensures that a small part of the pre-scroll display will appear at right or left (depending on the direction of scroll) of the post-scroll display.)

The first block following the switch converts the distance to scroll to the required negative value if the user is scrolling towards the right. The second block defeats any further scrolling action if the left scroll arrow is being used, the mouse button is still down and the document is at the minimum (left) scrolled position or the right scroll arrow is being used, the mouse button is still down and the document is at the maximum (right) scrolled position.

With the scroll distance determined, the call to the function `doMoveScrollBar` adds/subtracts the distance to scroll to/from the control's current value and repositions the scroll box/scroller accordingly.

At this stage, the picture scrolling takes place. If scrolling is being effected using the scroll arrows, `ScrollRect` scrolls the picture's pixels by the specified amount, and in the specified direction, as represented by the distance-to-scroll value. The "vacated" area is then added to the window's update region (previously empty) by the call to `InvalWindowRgn`, and `BeginUpdate` is called to ensure that, on Mac OS 8/9, only the "vacated" area will be redrawn and the update region is cleared.

Regardless of whether the picture is being scrolled using the scroll arrows or the gray areas, `SetOrigin` is then called to reset the window origin so that that part of the picture represented by the current scroll position is drawn. After the correct part of the picture is drawn, the window origin is reset to (0,0).

Finally, if `BeginUpdate` was called prior to the draw (that is, scrolling is being effected using the scroll arrows), `EndUpdate` is called.

### **actionFunctionLive**

`actionFunctionLive` is the action function for the live-feedback scroll bar.

The principal differences between this action function and the previous one are that action functions for live-feedback scroll bars must continually scroll the window's contents, not only while the mouse button remains down in the scroll arrows and gray areas/track, but also while the scroll box/scroller is being dragged. Accordingly, this action function, unlike the action function for the non-live-feedback scroll bar, is also called while the mouse button remains down in the scroll box/scroller.

If the mouse-down occurred in the scroll box/scroller, the code which sets up the scroll distance, adjusts the sign of the scroll distance according to whether the scroll is left or right,

prevents scrolling beyond the minimum and maximum scroll values, and calls `doMoveScrollBar` to move the scroll box/scroller and update the control's value, is bypassed. The call to `doMoveScrollBar` is bypassed because the live-feedback variant of the `CDEF` moves the scroll box/scroller and updates the control's value when the mouse-down is in the scroll box/scroller.

After the if block has been bypassed (mouse-down in the scroll box/scroller) or executed (mouse-down in the scroll arrows or gray area/track), the window contents are scrolled. Regardless of whether the picture is being scrolled using the scroll box/scroller, the scroll arrows, or the gray areas/track, `SetOrigin` is called to reset the window origin so that that part of the picture represented by the current scroll position is drawn by the call to `DrawPicture`. After the correct part of the picture is drawn, the window origin is reset to (0,0).

Note that this alternative approach to redrawing the picture when scrolling is being effected using the scroll arrows has not been dictated by the fact that this is a live-feedback action function. Either of these two approaches will work in both live-feedback and non-live-feedback action functions.

### **doMoveScrollBar**

`doMoveScrollBar` is called from within the action function to reset the control's current value to reflect the scrolled distance and to reposition the scroll box accordingly.

# Dialogs and Alerts

## CHAPTER

# 8

## IN THIS CHAPTER

- Introduction 340
- Alert Types, Modalities, and Levels 340
- Dialog Types and Modalities 342
- Window Types for Alerts and Dialogs 343
- Content of Alerts and Dialogs 345
- Removing Dialogs 345
- Creating and Removing Alerts 345
- Creating Dialogs 350
- Items in Dialogs 355
- Displaying Alerts and Dialogs 367
- Handling Events in Alerts and Dialogs 370
- Closing and Disposing of Dialogs 377
- Creating Displaying and Handling Window-Modal (Sheet) Alerts and Dialogs 378
- Balloon Help for Dialogs—Mac OS 8/9 379
- Help Tags for Dialogs—Mac OS X 382
- Main Dialog Manager Constants, Data Types and Functions 382
- Relevant Window Manager Functions (Mac OS X Only) 386
- Demonstration Program DialogAndAlerts Listing 386
- Demonstration Program DialogsAndAlerts Comments 413

## Introduction

Your application should present alerts to the user whenever an unexpected or undesirable situation occurs.

Before your application carries out a command, it may present a dialog to solicit additional information from the user or to allow the user to modify settings.

## Alert Types, Modalities, and Levels

### Alert Types and Modalities

There are three types of alert, namely, the **modal alert**, the **movable modal alert**, and, on Mac OS X only, the **sheet alert**. The three types are shown in Fig 1.

#### Modal Alert

The fixed-position modal alert places the user in the state, or **mode**, of being able to work only inside the alert. The only response the user receives when clicking anywhere outside the alert is the alert sound. The modal alert is thus **system-modal**, meaning that it denies user interaction with anything but the alert until it is dismissed.

There will be very few, if any, situations where the use of a modal alert in your application is justified.

#### Movable Modal Alert

Movable modal alerts retain the essentially modal characteristic of their fixed-position counterpart, the main differences being that they allow the user to drag the alert so as to uncover obscured areas of an underlying window and bring another application to the front. Movable modal alerts are thus **application-modal**.

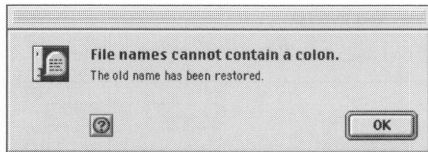
#### Window-Modal (Sheet) Alert—Mac OS X

Mac OS X introduced a new type of alert called the **sheet alert**. Sheet alerts, which are invariably attached to an owner window, are **window-modal**. The information conveyed by the alert, or the alternative actions requested, should pertain only to the document to whose window the alert is attached.

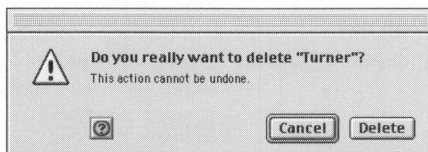
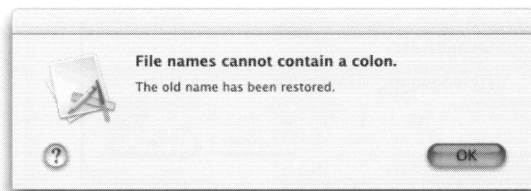
### Levels of Alert

Modal and movable modal alerts can display one of three levels of alert depending on the nature of the situation the alert is reporting to the user (see Fig 1). The three levels of alert, which, on Mac OS 8/9, are identified by icons supplied automatically by the system, are as follows:

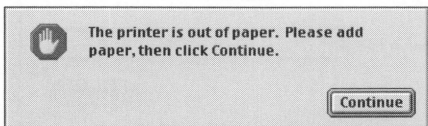
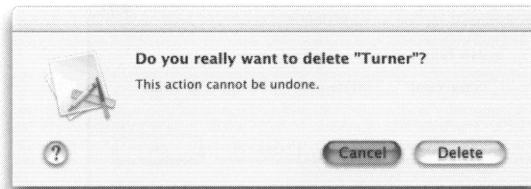
- **Note Level.** The note level is used to inform users of an occurrence that will not have serious consequences (see Fig 1). Usually, a note level alert simply offers information, although it may ask a simple question and provide, via the push buttons, a choice of responses.
- **Caution Level.** The caution level is used to alert the user to an operation that may have undesirable results if it is allowed to continue. As shown in Fig 1, you should provide the user, via the push buttons, with a choice of whether to continue with or back out of the operation.
- **Stop Level.** The stop level is used to inform the user of a situation so serious that the operation cannot proceed.



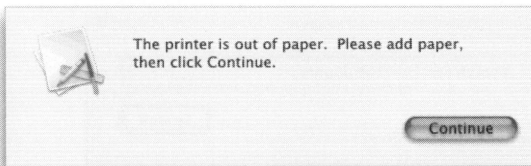
MOVABLE MODAL ALERT (NOTE LEVEL)



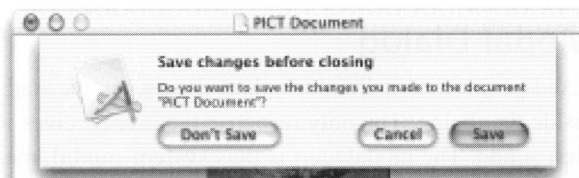
MOVABLE MODAL ALERT (CAUTION LEVEL)



MODAL ALERT (STOP LEVEL)



The Mac OS X window layering model, in which document windows from different applications can be interleaved, makes it necessary to indicate to the user which application is displaying the alert. This is achieved by the inclusion of the application's icon in the alert.



WINDOW-MODAL (SHEET) ALERT

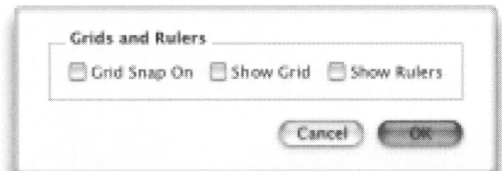
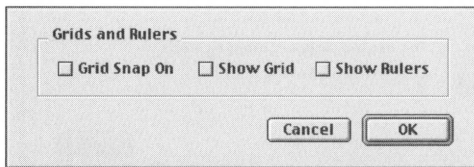
FIG 1 - TYPES AND LEVELS OF ALERTS



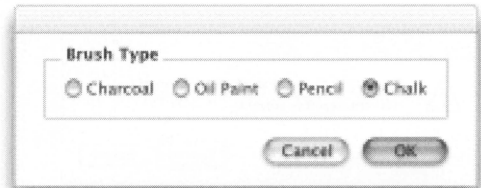
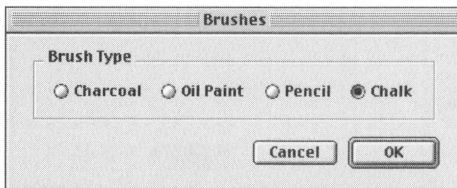
Note that, at the time of writing, there was no visual distinction between alert levels on Mac OS X, the application icon rather than distinct note, caution, and stop icons being displayed. At the time of writing, it was expected that Carbon would eventually support the “badging” of the application icon with alert level badges similar to the Mac OS 8/9 note, caution, and stop icons.

## Dialog Types and Modalities

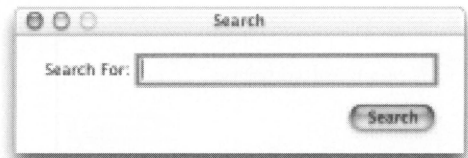
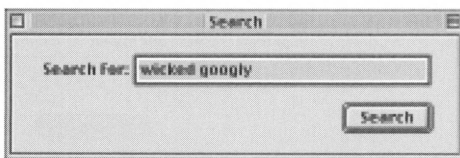
There are four types of dialog, namely, modal dialogs, movable modal dialogs, modeless dialogs, and, on Mac OS X only, sheet dialogs. The four types are illustrated in the examples in Fig 2.



MODAL DIALOG



MOVABLE MODAL DIALOG



MODELESS DIALOG

## Modal Dialog

Fixed-position modal dialogs place the user in the state, or mode, of being able to work only inside the dialog. The only response the user receives when clicking outside the dialog is the alert sound. The modal alert is thus **system-modal**, meaning that it denies user interaction with anything but the dialog until it is dismissed.



There will be very few, if any, situations where the use of a modal dialog in your application is justified.

## Movable Modal Dialog

Movable modal dialogs retain the essentially modal characteristic of their fixed-position counterpart, the main differences being that they allow the user to drag the dialog so as to uncover obscured areas of an underlying window and bring another application to the front. Movable modal dialogs are thus **application-modal**.

The absence of boxes/buttons in the title bar of a movable modal dialog visually indicates to the user that the dialog is modal rather than modeless.

## Modeless Dialog

Modeless dialogs look like document windows, except for their interior color/pattern and, on Mac OS 8/9, a one-pixel frame just inside the window frame. Unlike document windows, however, modeless dialogs should not contain scroll bars or a size box/resize control.

Modeless dialogs should not require the user to dismiss them before the user is able to do anything else. Thus modeless dialogs should be made to behave much like document windows in that the user should be able to move them, bring other windows in front of them, and close them.

Modeless dialogs should ordinarily not have a Cancel push button, although they may have a Stop push button to halt long operations such as searching.

## Window-Modal (Sheet) Dialog—Mac OS X

Mac OS X introduced a new type of dialog called the **sheet dialog**. Sheet dialogs, which are invariably attached to an owner window, are **window-modal**. The information or settings solicited by the dialog should pertain only to the document to whose window the dialog is attached.

## Window Types for Alerts and Dialogs

Fig 3 shows the seven (eight on Mac OS X) available window types for alerts and dialogs and the constants that represent the window definition IDs for those types. Note that modeless dialogs are a special case in that a normal document window type is used.



FIG 3 - WINDOW TYPES FOR DIALOGS AND ALERTS

The window definition ID is derived by multiplying the resource ID of the WDEF by 16 and adding the variation code to the result, as is shown in the following:

<i>WDEF Resource ID</i>	<i>Variation Code</i>	<i>Window Definition ID (Value)</i>	<i>Window Definition ID (Constant)</i>
65	0	$65 * 16 + 0 = 1040$	<code>kWindowPlainDialogProc</code>
65	1	$65 * 16 + 1 = 1041$	<code>kWindowShadowDialogProc</code>
65	2	$65 * 16 + 2 = 1042$	<code>kWindowModalDialogProc</code>
65	3	$65 * 16 + 3 = 1043$	<code>kWindowMovableModalDialogProc</code>
65	4	$65 * 16 + 4 = 1044$	<code>kWindowAlertProc</code>
65	5	$65 * 16 + 5 = 1045$	<code>kWindowMovableAlertProc</code>
65	6	$65 * 16 + 6 = 1046$	<code>kWindowMovableModalGrowProc</code>
64	0	$64 * 16 + 0 = 1024$	<code>kWindowDocumentProc</code> (Used for modeless dialogs.)
68	0	$68 * 16 + 0 = 1088$	<code>kWindowSheetProc</code>

## Content of Alerts and Dialogs

Alerts should usually contain only informative text and push button controls. Dialogs may contain informative or instructional text and controls.

### Default Push Buttons

Your application should specify a default push button for every alert and dialog. The default push button, visually identified by a default ring drawn around it (Mac OS 8/9) or pulsing blue (Mac OS X), should be the one the user is more likely to click in most circumstances. If the most likely choice is at all destructive (for example, erasing a disk or deleting a file), you should consider defining the Cancel button as the default. (See the caution alert in Fig 1.)

### Removing Dialogs

Your application should remove and dispose of a modal, movable modal, and window-modal (sheet) dialogs only when the user clicks one of its push buttons.

Your application should not remove a modeless dialog unless the user clicks its close box/button or chooses Close from the File menu when the modeless dialog is the active window. (Typically, a modeless dialog is simply hidden, not disposed of, when the user clicks the close box/button or chooses Close from the File menu.)

## Creating and Removing Alerts

Alerts may be created from resources using the functions `Alert`, `NoteAlert`, `CautionAlert` and `StopAlert`, which take descriptive information about the alert from alert ('ALRT') and extended alert ('alrx') resources. However, the preferred (and considerably simpler) method is to create alerts programmatically using the functions `StandardAlert` and, on Mac OS X only, `CreateStandardAlert`.

Fig 4 shows an alert created by `StandardAlert` and `CreateStandardAlert`.

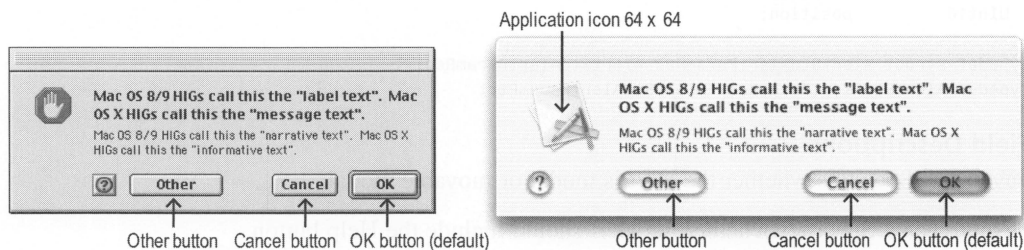


FIG 4 - ALERTS CREATED WITH `StandardAlert` AND `CreateStandardAlert`

## The StandardAlert Function

When an alert is created using the function `StandardAlert`, the alert is automatically sized based on the amount of text passed in to it, and push buttons are automatically sized and located.

```
OSErr StandardAlert(AlertType inAlertType, ConstStr255Param inError,
                   ConstStr255Param inExplanation,
                   const AlertStdAlertParamRec *inAlertParam, SInt16 *outItemHit);
```

`inAlertType` The level of alert. Relevant constants are:

```
kAlertStopAlert
kAlertNoteAlert
kAlertCautionAlert
kAlertPlainAlert
```

`inError` The label text (Mac OS 8/9) or message text (Mac OS X).

`inExplanation` The narrative text (Mac OS 8/9) or informative text (Mac OS X). NULL indicates no narrative/informative text.

`inAlertParam` A pointer to a **standard alert parameter structure** (see below). NULL indicates that none of the features provided by the standard alert structure are required.

`outItemHit` On return, contains the item number of the push button that the user hit.

### Standard Alert Parameter Structure

The standard alert parameter structure is as follows:

```
struct AlertStdAlertParamRec
{
    Boolean      movable;
    Boolean      helpButton;
    ModalFilterUPP filterProc;
    ConstStringPtr defaultText;
    ConstStringPtr cancelText;
    ConstStringPtr otherText;
    SInt16       defaultButton;
    SInt16       cancelButton;
    UInt16       position;
};
typedef struct AlertStdAlertParamRec AlertStdAlertParamRec;
typedef AlertStdAlertParamRec *AlertStdAlertParamPtr;
```

### Field Descriptions

`movable` Specifies whether the alert is modal or movable modal.

`helpButton` Specifies whether the alert should include the Help button.

**filterProc** Optionally, a universal procedure pointer to an application-defined event filter (callback) function. If NULL is assigned, the Dialog Manager uses the standard event filter (callback) function. (See Event Filter (Callback) Functions For Modal and Movable Modal Alerts and Dialogs later in this chapter.)

**defaultText** Optionally, text for the push button in the OK push button, position. (See Alert Default Text Constants.) The push button is automatically sized and positioned to accommodate the text.

## NOTE

The push button in the OK button position is not necessarily named OK. Human Interface Guidelines require that, wherever possible, buttons be named with a verb that describes the action that they perform. (As an example, see the buttons in Fig 1.)

**cancelText** Optionally, text for the push button in the Cancel push button position. (See Alert Default Text Constants later in this chapter.) The push button is automatically sized and positioned to accommodate the text. Pass NULL to specify that a Cancel push button should not be displayed.

**otherText** Optionally, text for the push button in leftmost position. (See Alert Default Text Constants later in this chapter.) The push button is automatically sized and positioned to accommodate the text. Pass NULL to specify that the leftmost push button should not be displayed.

**defaultButton** Specifies which push button is to act as the default push button. (See Alert Push Button Constants later in this chapter.)

**cancelButton** Specifies which push button is to act as the Cancel push button. Can be 0. (See Alert Button Constants later in this chapter.)

**position** The alert position. (See Positioning Specification, below, and note that, when these constants are used to specify alert position in an alert created programmatically using `StandardAlert`, the constant `kWindowDefaultPosition` has the same effect as `kWindowAlertPositionParentWindowScreen`.)

## Alert Default Text Constants

To specify the default text for the push buttons in the Right, Middle, and Leftmost push button positions, use these constants in the `defaultText`, `cancelText`, and `otherText` fields of the standard alert structure:

<i>Constant</i>	<i>Value</i>	<i>Button Position</i>	<i>Default Text</i>	<i>Where Used</i>
<code>kAlertDefaultOKText</code>	-1	Right	OK	<code>defaultText</code> field
<code>kAlertDefaultCancelText</code>	-1	Middle	Cancel	<code>cancelText</code> field
<code>kAlertDefaultOtherText</code>	-1	Leftmost	Don't Save	<code>otherText</code> field

## Alert Push Button Constants

To specify which push buttons act as the default and Cancel push buttons, use these constants in the `defaultButton` and `cancelButton` fields in the standard alert structure:

<i>Constant</i>	<i>Value</i>	<i>Meaning</i>
<code>kAlertStdAlertOKButton</code>	1	The OK push button.
<code>kAlertStdAlertCancelButton</code>	2	The Cancel push button.
<code>kAlertStdAlertOtherButton</code>	3	A third push button.

## Positioning Specification

The main constants for the positioning specification field are as follows:

<i>Constant</i>	<i>Value</i>	<i>Meaning</i>
<code>kWindowDefaultPosition</code> user is currently working.	<code>0x0000</code>	Alert position on screen where
<code>kWindowAlertPositionMainScreen</code>	<code>0x300A</code>	Alert position on main screen. (The main screen in a multi-monitor system is the screen on which the menu bar is located.)
<code>kWindowAlertPositionParentWindow</code>	<code>0xB00A</code>	Alert position on frontmost window.
<code>kWindowAlertPositionParentWindowScreen</code>	<code>0x700A</code>	Alert position on screen where user is currently working.
<code>kWindowCenterMainScreen</code>	<code>0x280A</code>	Center on main screen.
<code>kWindowCenterParentWindow</code>	<code>0xA80A</code>	Center on frontmost window.
<code>kWindowCenterParentWindowScreen</code>	<code>0x680A</code>	Center on screen where user is currently working.

## The CreateStandardAlert Function

On Mac OS X only, you may also use the function `CreateStandardAlert` to create an alert:

```
OSStatus CreateStandardAlert(AlertType inAlertType, CFStringRef inError,
                             CFStringRef inExplanation,
                             const AlertStdCFStringAlertParamRec *param,
                             DialogRef *outAlert);
```

The main differences between the `CreateStandardAlert` and `StandardAlert` functions are as follows:

- The `inError` and `inExplanation` fields take a `CFStringRef`.
- A pointer to a standard `CFString` alert parameter structure is passed in the `param` parameter. This structure is basically similar to the standard alert parameter structure except that:
  - It has no field for a universal procedure pointer to an event filter (callback) function.
  - The `defaultText`, `cancelText`, and `otherText` fields are of type `CFStringRef`.
  - It has an additional field (`flags`) in which bits can be set to specify options for the behavior of the dialog. Setting the `kStdAlertDoNotDisposeSheet` bit in this field when the dialog is a sheet causes the sheet not to be disposed of after it is hidden.

A call to the function `GetStandardAlertDefaultParams` initializes a standard `CFString` alert parameter structure with default values. (The defaults are: not movable, no Help button, no Cancel button, no Other button, alert position on parent window screen.)

- On return, a pointer to a dialog reference is received in the `outAlert` parameter. This must be passed in a call to the function `RunStandardAlert`, which displays the alert and handles user interaction. A universal procedure pointer to an event filter (callback) function may be passed in the `filterProc` parameter of this function. On return, the item number of the push button that the user hit is received in the `outItemHit` parameter of `RunStandardAlert`.

## Removal of Alerts

The Dialog Manager automatically removes and disposes of an alert when the user clicks a push button.



## Creating Dialogs

Dialogs may be created in one of the following ways:

- You can create dialogs from resources using the function `GetNewDialog`, which takes descriptive information about the dialog from **dialog** ('DLOG') and **extended dialog** ('dlgx') **resources**. The resource ID of the 'DLOG' and 'dlgx' resources must be the same, and is passed in the first parameter of this function.
- You can create dialogs programmatically using the function `NewFeaturesDialog`. `NewFeaturesDialog` has a `flags` parameter containing the same flags you would set in an extended dialog resource when creating the dialog from resources.

Regardless of which method is used to create the dialog, a **dialog object** will be created, and a pointer to that object will be returned to the calling function. The dialog object itself includes a window object.

## The Dialog Object

Dialog objects are opaque data structures in which the Dialog Manager stores information about individual dialogs. The data type `DialogRef` is defined as a pointer to a dialog object:

```
typedef struct OpaqueDialogPtr *DialogPtr;  
typedef DialogPtr DialogRef;
```

## Accessor Functions

The following accessor functions are provided to access the information in dialog objects.

<i>Function</i>	<i>Description</i>
<code>GetDialogWindow</code>	Gets a reference to the dialog's window object.
<code>GetDialogTextEditHandle</code>	Gets a handle to the <code>TERec</code> structure (which is re-used for all edit text items).
<code>GetDialogKeyboardFocusItem</code>	Gets item number of the item with keyboard focus.
<code>GetDialogDefaultItem</code>	Gets the item number of the default push button.
<code>SetDialogDefaultItem</code>	Tells the Dialog Manager the item number of the default push button.
<code>GetDialogCancelItem</code>	Gets the item number of the default Cancel push button.
<code>SetDialogCancelItem</code>	Tells the Dialog Manager the item number of the default Cancel button.
<code>AppendDITL</code>	Add items to, and remove items from, a dialog.
<code>AppendDialogItemList</code>	
<code>ShortenDITL</code>	
<code>InsertDialogItem</code>	
<code>RemoveDialogItem</code>	

# 'DLOG' and 'dlgx' Resources

## Structure of a Compiled 'DLOG' Resource

Fig 5 shows the structure of a compiled 'DLOG' resource and how it "feeds" the dialog object.

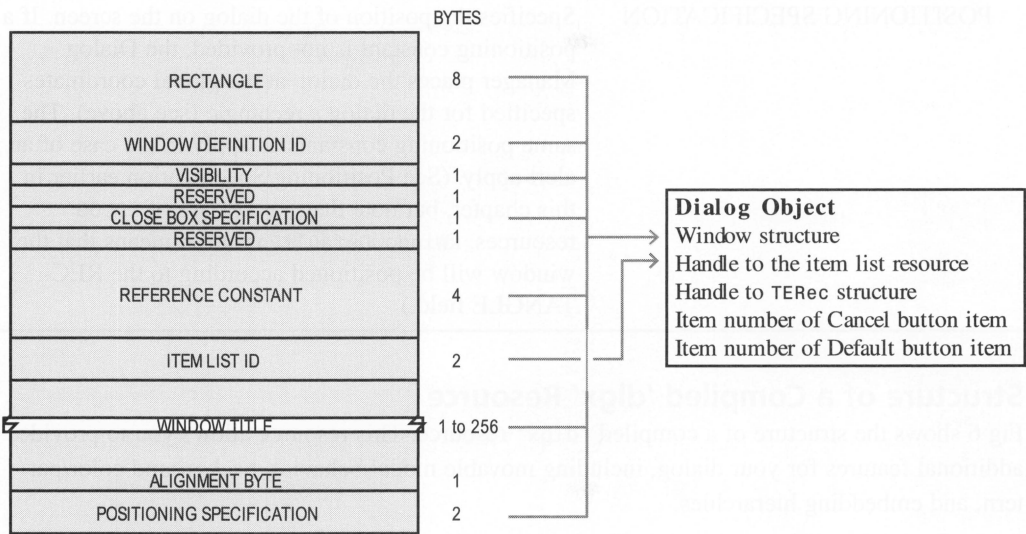


FIG 5 - STRUCTURE OF A COMPILED DIALOG ('DLOG') RESOURCE

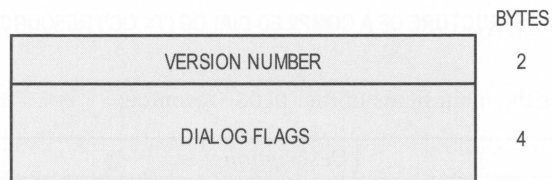
The following describes the main fields of the 'DLOG' resource:

Field	Description
RECTANGLE	The dialog's dimensions and, if a positioning specification (see below) is not specified, its location.
WINDOW DEFINITION ID	The window definition ID. (See Window Types For Alerts and Dialogs earlier in this chapter.)
VISIBILITY	If set to 1, the Dialog Manager displays the dialog as soon as <code>GetNewDialog</code> is called. If set to 0, the dialog is not displayed until <code>ShowWindow</code> is called.
CLOSE BOX SPECIFICATION	Specifies whether to draw a close box/button. Ordinarily, a close box/button is specified only for modeless dialogs.
REFERENCE CONSTANT	Applications can store any value here. For example, an application might store a number that represents the dialog type. <code>SetWRefCon</code> and <code>GetWRefCon</code> may be used to set and get this value.

<i>Field</i>	<i>Description</i>
ITEM LIST ID	Resource ID of the item list resource.
WINDOW TITLE	The title displayed in the dialog's title bar (modeless and movable modal dialogs only).
POSITIONING SPECIFICATION	Specifies the position of the dialog on the screen. If a positioning constant is not provided, the Dialog Manager places the dialog at the global coordinates specified for the dialog's rectangle (see above). The same positioning constants as apply in the case of an alert apply. (See Positioning Specification earlier in this chapter, but note that, in the case of 'DLOG' resources, <code>kWindowDefaultPosition</code> means that the window will be positioned according to the RECTANGLE field.)

### Structure of a Compiled 'dlgx' Resource

Fig 6 shows the structure of a compiled 'dlgx' resource. This resource allows you to provide additional features for your dialog, including movable modal behavior, background color/pattern, and embedding hierarchies.



**FIG 6 - STRUCTURE OF A COMPILED DIALOG ('dlgx') RESOURCE**

The following describes the main field of the 'dlgx' resource:

<i>Field</i>	<i>Description</i>
DIALOG FLAGS	Constants that specify the dialog's Appearance features. (See Dialog Feature Flag Constants later in this chapter.)

### Dialog Feature Flag Constants

You can set the following bits in the dialog flags field of a 'dlgx' resource to specify the dialog's features:

Constant	Bit	Meaning If Set
kDialogFlagsUseThemeBackground	0	The Dialog Manager sets the correct dialog background color/pattern.
kDialogFlagsUseControlHierarchy	1	A root control is created and an embedding hierarchy is established. <b>Note:</b> All items in a dialog automatically become controls when embedding hierarchy is established.
kDialogFlagsHandleMovableModal	2	The dialog will be movable modal (in which case you must use kWindowMovableModalDialogProc window definition ID). (The Dialog Manager handles movable modal behavior.)
kDialogFlagsUseThemeControls	3	All controls created by the Dialog Manager will be compliant with the Platinum appearance.

Creating 'dlgx' and 'DLOG' Resources Using Resorcerer

Creating 'dlgx' Resources

Fig 7 shows a 'dlgx' resource being created with Resorcerer.

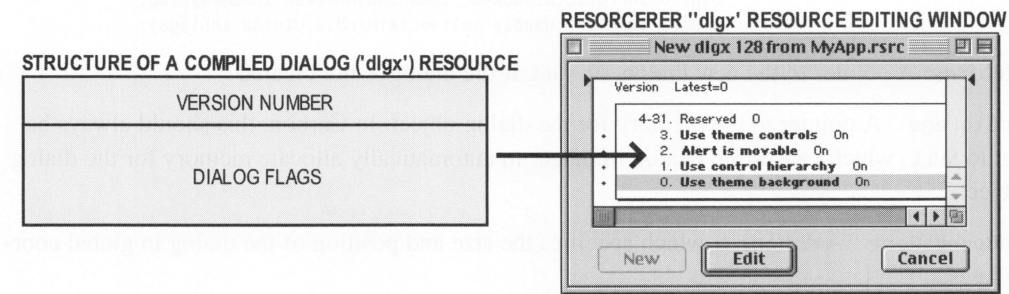


FIG 7 - CREATING A 'dlgx' RESOURCE USING RESORCERER

Creating 'DLOG' Resources

Fig 8 shows a 'DLOG' resource being created with Resorcerer.

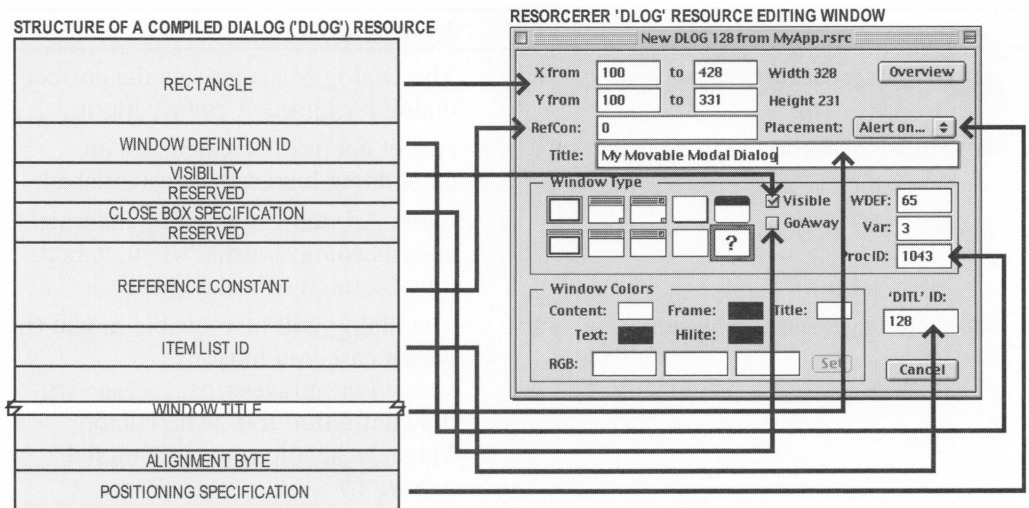


FIG 8 - CREATING A 'DLOG' RESOURCE USING RESORCERER

## The NewFeaturesDialog Function

The function `NewFeaturesDialog` creates a dialog from the information passed in its parameters.

```
DialogRef NewFeaturesDialog(void *inStorage, const Rect *inBoundsRect,
                           ConstStr255Param inTitle, Boolean inIsVisible,
                           SInt16 inProcID, WindowRef inBehind, Boolean inGoAwayFlag,
                           SInt32 inRefCon, Handle inItemHandle, UInt32 inFlags);
```

**Returns:** A pointer to the new dialog, or NULL if the dialog is not created

**inStorage** A pointer to the memory for the dialog object. In Carbon, this should always be set to NULL, which causes the Dialog Manager to automatically allocate memory for the dialog object.

**inBoundsRect** A rectangle, which specifies the size and position of the dialog in global coordinates.

**inTitle** The title of a modeless or movable modal dialog. You can specify an empty string (not NULL) if the dialog is to have no title. (In C, you specify an empty string by two double quotation marks (" ").)

**inIsVisible** Specifies whether the dialog should be drawn immediately after `NewFeatureDialog` is called. If this parameter is set to false, `ShowWindow` must be called to display the dialog.

**inProcID** The window definition ID for the type of dialog. Pass `kWindowModalDialogProc` in this parameter to specify modal dialogs, `kWindowMovableModalDialogProc` to specify movable modal dialogs, and `kWindowDocumentProc` to specify modeless dialogs.

**inBehind** A reference to the window behind which the dialog is to be opened. Pass `(WindowRef) -1` in this parameter to open the dialog in front of all other windows.

**inGoAwayFlag** Passing `true` in this parameter causes a close box/button to be drawn in the title bar. `true` should only be passed when a modeless dialog is being created.

**inRefCon** A reference constant that the Dialog Manager stores in the dialog's window object. Applications can store any value here. For example, an application might store a number that represents the dialog type. `GetWRefCon` may be used to retrieve this value.

**inItemHandle** A handle to the item list resource, which you can get by calling `GetResource` to read the item list resource into memory.

**inFlags** The dialog's feature flags. (See Dialog Feature Flag Constants earlier in this chapter.)

Although the `inItemHandle` parameter specifies an item list ('DITL') resource for the dialog, the corresponding dialog font table ('dftb') resource (see below) is not automatically accessed. You must explicitly set the dialog's control font styles individually.

## Items in Dialogs

### Preamble—Dialog Manager Primitives

Dialogs contain items, such as push buttons, radio buttons, and checkboxes. Prior to the introduction of Mac OS 8 and the Appearance Manager, an actual control could be an item; however, items such as push buttons and radio buttons were not controls as such but rather **Dialog Manager primitives**.

These primitives may still be specified in item list resources (see following). However, when a root control has been created for the dialog window, thus creating an embedding hierarchy for controls, the Dialog Manager replaces any primitives in the dialog with their control counterparts (except for the primitive called a **user item**).

The situation where all items in a dialog are controls has many advantages. For example, all controls within the dialog can be activated and deactivated by simply activating and deactivating the root control.



The primitives, and their control equivalents, are as follows:

<i>Dialog Manager Primitive</i>	<i>Control Equivalent</i>
Button	Push button.
Radio Button	Radio button.
Checkbox	Checkbox.
Edit Text	Edit text control.
Static Text	Static text control.
Icon. (An icon whose black and white resource is stored in an 'ICON' resource and whose color version is stored in a 'cicn' resource with the same ID.)	Icon control (no track variant).
Picture. (Picture stored in a 'PICT' resource.)	Picture control (no track variant).
User Item. (An application-defined item. For example, an application-defined drawing function could be installed in a user item.)	(No control equivalent.)

## The 'DITL' Resource

A ('DITL') resource is used to store information about all the items in a dialog. The 'DITL' resource ID is specified in the associated 'DLOG' resource, or a handle to the 'DITL' resource is passed in the `inItemListHandle` parameter of the `NewFeaturesDialog` function. 'DITL' resources should be marked as purgeable.

Items are usually referred to by their position in the item list, that is, by their item number.

Several independent dialogs may use the same 'DITL' resource. `AppendDITL`, `AppendDialogItemList`, and `ShortenDITL` may be used to modify or customize copies of shared item list resources for use in individual dialogs.

Fig 9 shows the structure of a compiled 'DITL' resource and one of its constituent items, in this case a control item.



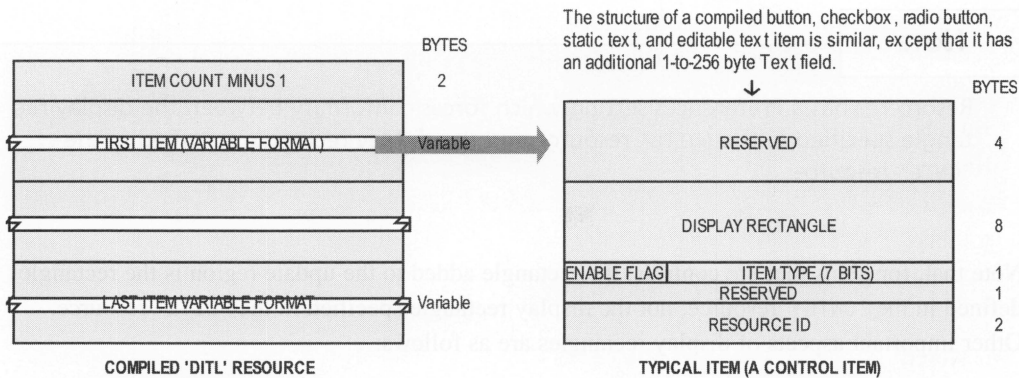


FIG 9 - STRUCTURE OF A COMPILED ITEM LIST ('DITL') RESOURCE AND A TYPICAL ITEM

The following describes the fields of the 'DITL' resource and the control item:

Field	Description
ITEM COUNT MINUS 1	A value equal to one less than the number of items in the resource.
FIRST ITEM ... LAST ITEM	(The format of each item depends on its type.)
DISPLAY RECTANGLE	The size and location, in local coordinates, of the item within the dialog. (See Display Rectangles later in this chapter.)
ENABLE FLAG	Specifies whether the item is enabled or disabled. If this bit is set (item is enabled) the Dialog Manager reports all mouse-down events in the item to your application
ITEM TYPE	The item type.
RESOURCE ID	For a control item, the resource ID of the 'CNTL' resource.

Display Rectangles

The enclosing rectangle you specify in a control's 'CNTL' resource should be identical to the display rectangle specified in the 'DITL' resource.

**NOTE**

Resorcerer has a Preferences setting which forces conformity between the display rectangle specified in the 'DITL' resource and the display rectangle specified in the 'CNTL' resource.

Note that, for items that are controls, the rectangle added to the update region is the rectangle defined in the 'CNTL' resource, not the display rectangle specified in the 'DITL' resource. Other important aspects of display rectangles are as follows:

- **Edit Text Items.** In edit text items, the display rectangle is the TextEdit **destination rectangle** and **view rectangle** (see Chapter 21). For display rectangles that are large enough to contain more than one line of text, word wrapping occurs within the rectangle. The text is clipped if it overflows the rectangle.
- **Static Text Item.** Static text items are drawn within the display rectangle in the same manner as edit text items except that a frame is not drawn around the text.
- **Icon and Picture Items.** Icons and pictures larger than the display rectangle are scaled so as to fit the display rectangle.
- The Dialog Manager considers a click anywhere in the display rectangle to be a click in that item. In the case of a click in the overlap area of overlapping display rectangles, the Dialog Manager reports the click as occurring in the item that appears first in the item list.

## Creating a 'DITL' Resource Using Resorcerer

Fig 10 shows a 'DITL' resource being created with Resorcerer. Two items are being edited (Item 1 and Item 2). Item 1 is a Dialog Manager primitive. Item 2 is a control.

## Layout Guidelines for Dialogs

Layout guidelines for items in dialogs are contained in the Apple publications Mac OS 8 Human Interface Guidelines (Mac OS 8/9) and Aqua Human Interface Guidelines (Mac OS X). These guidelines are not consistent on matters such as the required sizes of certain items and, more particularly, the required spacing between items. For Carbon applications, it is best to observe the Aqua interface guidelines when laying out dialog items.

## Default Push Buttons

You should give every dialog a default push button, except for those that contain edit text items that accept Return key presses. If you do not provide an event filter (callback) function (see

Event Filter (Callback) Functions For Modal and Movable Modal Alerts and Dialogs later in this chapter) which specifies otherwise, the Dialog Manager treats the first item in the item list resource as the default push button for the purpose of responding to Return and Enter key presses.

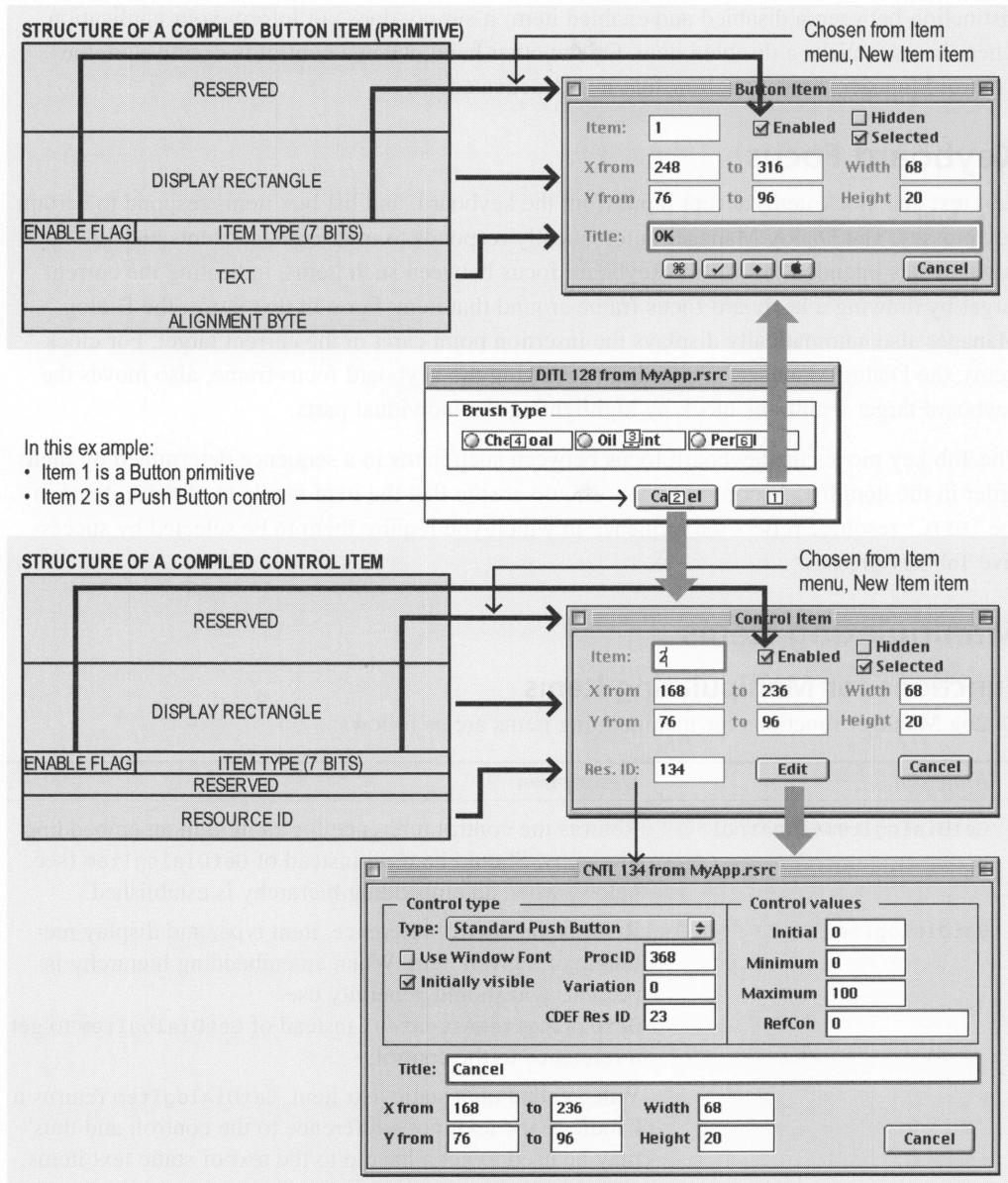


FIG 10 - CREATING A 'DITL' RESOURCE USING RESORCERER

## Enabling and Disabling Items

You should not necessarily enable all items. For example, you typically disable static text items and edit text items because your application does not need to respond to clicks in those items.

Note that *disabled* is not the same thing as a *deactivated*. The Dialog Manager makes no visual distinction between a disabled and enabled item; it simply does not inform your application when the user clicks a disabled item. On the other hand, when a control is deactivated, the Control Manager dims it to show that it is deactivated.

## Keyboard Focus

Edit text and clock items accept input from the keyboard, and list box items respond to certain key presses. The Dialog Manager automatically responds to mouse-down events and Tab key-down events intended to shift the keyboard focus between such items, indicating the current target by drawing a keyboard focus frame around that item. For edit text items, the Dialog Manager also automatically displays the insertion point caret in the current target. For clock items, the Dialog Manager, in addition to drawing the keyboard focus frame, also moves the keyboard target within the clock by highlighting the individual parts.

The Tab key moves the keyboard focus between such items in a sequence determined by their order in the item list. Accordingly, you should ensure that the item numbers of these items in the 'DITL' resource reflect the sequence in which you require them to be selected by successive Tab key presses.

## Manipulating Items

### Functions for Manipulating Items

Dialog Manager functions for manipulating items are as follows:

Function	Description
GetDialogItemAsControl	Returns the control reference for an item in an embedding hierarchy. Should be used instead of GetDialogItem (see below) when an embedding hierarchy is established.
GetDialogItem	Returns the control reference, item type, and display rectangle of a given item. When an embedding hierarchy is present, you should generally use GetDialogItemAsControl instead of GetDialogItem to get a reference to the control.  When called on a static text item, GetDialogItem returns a handle to the text, not a reference to the control, and thus may be used to get a handle to the text of static text items. (When called on a static text item, GetDialogItemAsControl returns a reference to the control, not a handle to the text.)

<i>Function</i>	<i>Description</i>
<code>SetDialogItem</code>	When an embedding hierarchy does not exist, sets the item type, reference, and display rectangle of an item. (When an embedding hierarchy exists, you cannot change the type or reference of an item.)
<code>HideDialogItem</code>	Hides the given item.
<code>ShowDialogItem</code>	Re-displays a hidden item.
<code>GetDialogItemText</code>	Returns the text of an edit or static text item.
<code>SelectDialogItemText</code>	Selects the text of an edit text item. When embedding is on, you should pass in the control reference produced by a call to <code>GetDialogItemAsControl</code> . When embedding is not on, you should pass in the reference produced by a call to <code>GetDialogItem</code> .
<code>FindDialogItem</code>	Determines the item number of an item at a particular location in a dialog.
<code>MoveDialogItem</code>	Moves a dialog item to a specified location in a window. Ensures that, if the item is a control, the control rectangle and the dialog item rectangle (maintained by the Dialog Manager) are always the same.
<code>SizeDialogItem</code>	Resizes a dialog item to a specified size. If the dialog item is a control, the control rectangle and the dialog item rectangle (maintained by the Dialog Manager) are always the same.
<code>CountDITL</code>	Counts items in a dialog.
<code>AppendDITL</code>	Adds items to the end of the item list.
<code>AppendDialogItemList</code>	(See Append Method Constants, below.)
<code>ShortenDITL</code>	Removes items from the end of the item list.
<code>InsertDialogItem</code>	Inserts an item into the item list.
<code>RemoveDialogItem</code>	Removes an item from the item list.
<code>ParamText</code>	Substitutes up to four different text strings in static text control items.

### Append Method Constants

The `AppendDITL`, `AppendDialogItemList`, and `ShortenDITL` functions are particularly useful in the situation where more than one dialog shares the same 'DITL' resource and you want to tailor the 'DITL' for each dialog. When calling `AppendDITL` or `AppendDialogItemList`, you specify a new 'DITL' resource to append to the relevant dialog's existing 'DITL' resource. You also specify where the Dialog Manager should display the new items by using one of the following constants in the `AppendDITL` or `AppendDialogItemList` call:



<i>Constant</i>	<i>Value</i>	<i>Description</i>
overlay	0	Overlay existing items. Coordinates of the display rectangle are interpreted as local coordinates within the dialog.
AppendDITLRight	1	Append at right. Display rectangles are interpreted as relative to the upper-right coordinate of the dialog.
appendDITLBottom	2	Append at bottom. Display rectangles are interpreted as relative to the lower-left coordinate of the dialog.

As an alternative to passing these constants, you can append items relative to an existing item by passing a negative number to `AppendDITL` or `AppendDialogItemList`. The absolute value of this number represents the item relative to which the new items are to be positioned. For example, -3 would cause the display rectangles of the appended items to be offset from the upper-left corner of item number 3 in the dialog.

To use, at a later time, the unmodified version of a dialog whose contents and (possibly) size have been modified by `AppendDITL` or `AppendDialogItemList`, you should call `ReleaseResource` to release the memory occupied by the appended item list.

## Getting and Setting the Text in Edit Text and Static Text Items

Dialog Manager functions for getting text from, and setting the text of, edit text and static text items are as follows:

<i>Function</i>	<i>Description</i>
<code>GetDialogItemText</code>	Gets a copy of the text in static text and edit text items. Pass in the reference produced by a call to <code>GetDialogItem</code> , which gets a handle to the text in this instance, not a reference to the control.
<code>SetDialogItemText</code>	Sets the text string for static text and edit text items. When embedding is on, you should pass in the control reference produced by a call to <code>GetDialogItemAsControl</code> . If embedding is not on, pass in the reference produced by <code>GetDialogItem</code> .

The function `ParamText` may also be used to set the text string in a static text item in a dialog. A common example is the inclusion of the window title in static text such as “Save changes to the document ... before closing?”. In this case, the window’s title could be retrieved using `GetWTitle` and inserted by `ParamText` at the appropriate text replacement variable (^0, ^1, ^2 or ^3) specified in the static text item in the 'DITL' resource.

Since there are four text replacement variables, `ParamText` can supply up to four text strings for a single dialog.

## Setting the Font for Controls in a Dialog—'dftb' Resources

When an embedding hierarchy is established in a dialog, you can specify the initial font settings for all controls in a dialog by creating a dialog font table resource (resource type 'dftb') with the same resource ID as the alert or dialog's 'DITL' resource. When a 'dftb' resource is read in, the control font styles are set, and the resource is marked purgeable.

The 'dftb' resource is the resource-based equivalent of the programmatic method of setting a control's font using the function `SetControlFontStyle` described in Chapter 7.

### Structure of a Compiled 'dftb' Resource

Fig 11 shows the structure of a compiled 'dftb' resource and of a constituent dialog font table entry.

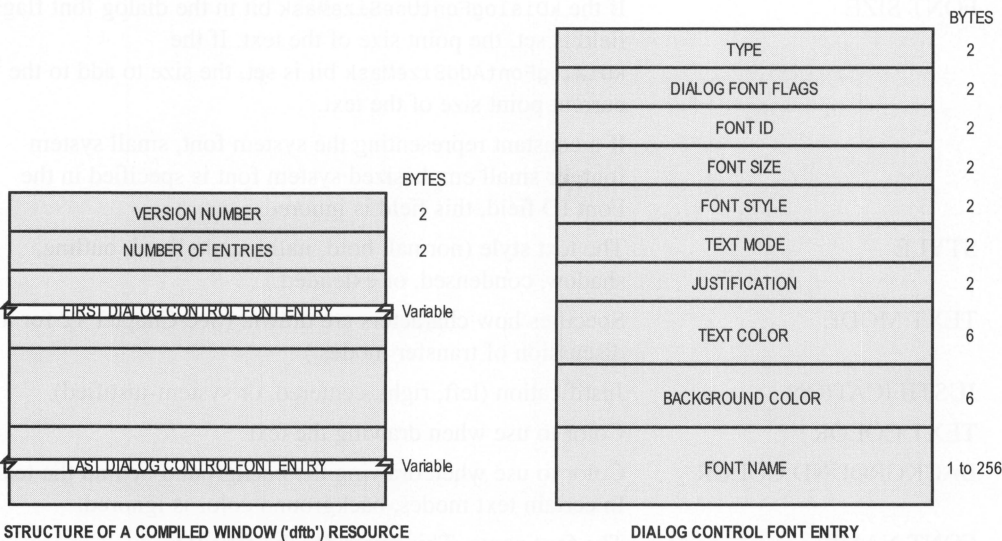


FIG 11- STRUCTURE OF A COMPILED DIALOG FONT TABLE ('dftb') RESOURCE AND A DIALOG CONTROL FONT ENTRY

The following describes the main fields of the 'dftb' resource and the dialog control font entry:

Field	Description
NUMBER OF ENTRIES	Specifies the number of entries in the resource. Each entry is a dialog control font structure.
FIRST DIALOG CONTROL FONT ENTRY...	Dialog control font structures. Each comprises type, dialog font flags, font ID, font size, font style, text mode, justification, text color, background color, and font name.
LASTDIALOG CONTROL	



<i>Field</i>	<i>Description</i>
FONT ENTRY TYPE	Specifies whether there is font information for the dialog or alert item in the 'DITL'. 0 means that there is no font information for the item, that no data follows, and that the entry is to be skipped. 1 means that there is font information for the item, and that the rest of the structure is read.
DIALOG FONT FLAGS	Specifies which of the following fields in the dialog font table should be used. (See Dialog Font Flag Constants later in this chapter.)
FONT ID	The ID of the font family to use. (See Meta Font Constants in the next section for more information about the constants that you can specify.) If this bit is set to 0, the system default font is used.
FONT SIZE	If the kDialogFontUseSizeMask bit in the dialog font flags field is set, the point size of the text. If the kDialogFontAddSizeMask bit is set, the size to add to the current point size of the text.  If a constant representing the system font, small system font, or small emphasized system font is specified in the Font ID field, this field is ignored.
STYLE	The text style (normal, bold, italic, underlined, outline, shadow, condensed, or extended.)
TEXT MODE	Specifies how characters are drawn. (See Chapter 12 for a discussion of transfer modes.)
JUSTIFICATION	Justification (left, right, centered, or system-justified).
TEXT COLOR	Color to use when drawing the text.
BACKGROUND COLOR	Color to use when drawing the background behind the text. In certain text modes, background color is ignored.
FONT NAME	The font name. This overrides the font ID.

### Dialog Font Flag Constants

You can set the following bits in the dialog font flags field of a dialog control font entry to specify the fields in the entry that should be used

<i>Constant</i>	<i>Value</i>	<i>Meaning</i>
kDialogFontNoFontStyle	0x0000	No font style information is applied.
kDialogFontUseFontMask	0x0001	The specified font ID is applied.
kDialogFontUseFaceMask	0x0002	The specified font style is applied.
kDialogFontUseSizeMask	0x0004	The specified font size is applied.
kDialogFontUseForeColorMask	0x0008	The specified text color is applied. This flag only applies to static text controls.
kDialogFontUseBackColorMask	0x0010	The specified background color is applied. This flag only applies to static text controls.
kDialogFontUseModeMask	0x0020	The specified text mode is applied.
kDialogFontUseJustMask	0x0040	The specified text justification is applied.
kDialogFontUseAllMask	0x00FF	All flags in this mask will be set except kDialogFontAddFontSizeMask and kDialogFontUseFontNameMask.
kDialogFontAddFontSizeMask	0x0100	The specified font size will be added to the existing font size specified in the Font Size field of the dialog font table resource.
kDialogFontUseFontNameMask	0x0200	The string in the Font Name field will be used for the font name instead of the specified font ID.

### Meta Font Constants

You can use the following meta font constants in the font ID field of a dialog control font entry to specify the style, size, and font family of a control's font. You should use these meta font constants whenever possible because, on Mac OS 8/9, the system font can be changed by the user. If none of these constants are specified, the control uses the system font unless a control with a variant that uses the window font has been specified.

<i>Constant</i>	<i>Value</i>	<i>Meaning In Roman Script System</i>
kControlFontBigSystemFont	-1	Use the system font.
kControlFontSmallSystemFont	-2	Use the small system font.
kControlFontSmallBoldSystemFont	-3	Use the small bold system font.
kControlFontSmallBoldSystemFont	-4	Use the small emphasized system font.

Another advantage of using these meta font constants is that you can be sure of getting the correct font on a Macintosh using a different script system, such as kanji.

## Creating a 'dftb' Resource Using Resorcerer

Fig 12 shows a dialog control font entry in a 'dftb' resource being edited with Resorcerer.

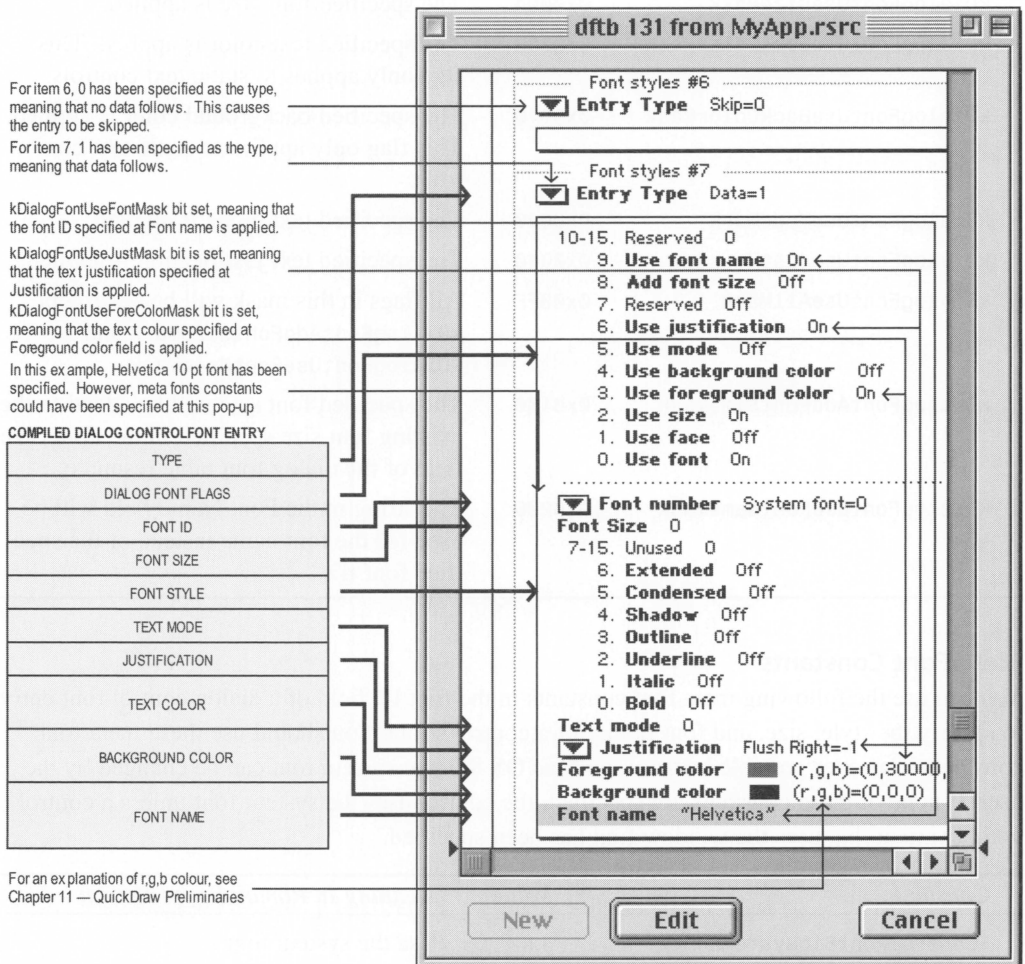


FIG 12 - CREATING A 'dftb' RESOURCE USING RESORCERER

## Displaying Alerts and Dialogs

As previously stated

- `StandardAlert`, `CreateStandardAlert` and `RunStandardAlert` are used to create and display alerts.
- `GetNewDialog` is used to create dialogs using descriptive information supplied by 'DLOG' and 'dlgx' resources, and `NewFeaturesDialog` is used to create dialogs programmatically. Both creation methods allow you to specify whether the dialog is to be initially visible, and both allow you to specify whether the dialog is to be brought to the front of all other windows when it is opened.

To display a dialog that is specified to be invisible on creation, you must call `ShowWindow` following the `GetNewDialog` or `NewFeaturesDialog` call to display the dialog. In addition, you should invariably pass `(WindowRef) -1` in the `behind` and `inBehind` parameters of, respectively, `GetNewDialog` and `NewFeaturesDialog` call so as to display a dialog as the active (frontmost) window.

## Window Deactivation and Menu Adjustment

When an alert or dialog is displayed

- The frontmost window (assuming one exists) must be deactivated.
- The application's menus must be adjusted to reflect the differing levels of permitted menu access that apply in the presence of the various types of alert and dialog. (As will be seen, the system software automatically performs some of this menu adjustment for you.)

### NOTE

Prior to the introduction of Mac OS 8 and the Appearance Manager, window deactivation when a movable modal dialog was displayed was handled in the same way as applies in the case of a modeless dialog, that is, within the application's main event loop. However, with the introduction of the Appearance Manager, when the `kDialogFlagsHandleMovableModal` bit is set in the 'dlgx' resource, or in the `inFlags` parameter of `NewFeaturesDialog`, `ModalDialog` is used to handle all user interaction within the dialog. (Previously, this user interaction was handled within the main event loop.) This has implications for the way your application deactivates the front window when a movable modal dialog is displayed.

Prior to the introduction of Mac OS 8 and the Appearance Manager, menu adjustment when a movable modal dialog was displayed was performed by the application. However, when a movable modal dialog is created by setting the `kDialogFlagsHandleMovableModal` bit in the 'dlgx' resource, or in the `inFlags` parameter of `NewFeaturesDialog`, menu adjustment is performed by the Dialog Manager and Menu Manager.

All that follows assumes that the `kDialogFlagsHandleMovableModal` bit is set in the 'dlgx' resource, or in the `inFlags` parameter of `NewFeaturesDialog`, and that, as a consequence:

- Your application calls `ModalDialog` to handle all user interaction within movable modal dialogs (as is the case with modal dialogs).
- Menu adjustment will be performed automatically by the Dialog Manager and Menu Manager when a movable modal dialog is displayed (as is the case with modal dialogs).

## Window Deactivation—Modeless Dialogs

You do not have to deactivate the front window *explicitly* when displaying a modeless dialog. The Event Manager continues sending your application activate events for your windows as needed, which you typically handle in your main event loop.

## Window Deactivation—Modal and Movable Modal Alerts and Dialogs

When a modal or movable modal alert or dialog is created and displayed, your application (in the case of dialogs) or `StandardAlert` and `RunStandardAlert` (in the case of alerts) calls `ModalDialog` to handle all user interaction within the alert or dialog until the alert or dialog is dismissed. Events, which are ordinarily handled within your application's main event loop, will then be trapped and handled by `ModalDialog`. This means that your window activation/deactivation function will not now be called as it normally would following the opening of a new window. Accordingly, if one of your application's windows is active, you must *explicitly* deactivate it before displaying a modal or movable modal alert or dialog.

## Menu Adjustment—Modeless Dialogs

When your application displays a modeless dialog, it is responsible for all menu disabling and enabling. Your application should thus perform the following tasks:

- Disable those menus whose items are not relevant to the modeless dialog.
- For modeless dialogs that contain edit text controls, enable the Edit menu and support the Cut, Copy, Paste, and Clear items using the Dialog Manager functions `DialogCut`, `DialogCopy`, `DialogPaste` and `DialogDelete`.



Your application is also responsible for all menu enabling when a modeless dialog is dismissed.

## Menu Adjustment—Modal Alerts and Dialogs

When your application displays a modal alert or dialog, the Dialog Manager and Menu Manager interact to provide varying degrees of access to the menus in your menu bar, as follows:

- On Mac OS 8/9, the Mac OS 8/9 Application menu, and all items in the Help menu except the Show Balloons/Hide Balloons items are disabled. On Mac OS X, all but the Apple and Application menus are disabled.
- Your application's menus are disabled.
- If the modal dialog contains a visible and active edit text item, the Edit menu and its Cut, Copy, and Paste items are enabled.

When the user dismisses the modal alert or dialog, the Menu Manager restores all menus to their previous state.

## Menu Adjustment—Movable Modal Alerts and Dialogs

When your application displays a movable modal alert or dialog, the Dialog Manager and Menu Manager interact to provide the same access to the menus in your menu bar as applies in the case of modal alerts and dialogs except that, in this case, on Mac OS 8/9, the Help and Mac OS 8/9 Application menus are left enabled.

When the user dismisses the movable modal alert or dialog, the Menu Manager restores all menus to their previous state.

## Displaying Multiple Alerts and Dialogs

The user should never see more than one modal dialog and one modal alert on the screen simultaneously. However, you can present multiple simultaneous modeless dialogs just as you can present multiple document windows.

## Resizing a Dialog

You can use the function `AutoSizeDialog` to automatically resize static text items and their dialogs to accommodate changed static text. For each static text item found, `AutoSizeDialog` adjusts the static text control and the bottom of the dialog window. Any items below a static text control are moved down.

## Handling Events in Alerts and Dialogs

### Overview

#### Modal and Movable Modal Alerts and Dialogs

When `StandardAlert`, `CreateStandardAlert`, and `RunStandardAlert` are used to create and display alerts, the Dialog Manager handles all of the events generated by the user until the user clicks a push button. When the user clicks a push button, these functions highlight the push button briefly, close the alert and report the user's selection to the application.

As previously stated, `ModalDialog` handles all user interaction within modal and movable modal dialogs. When the user selects an enabled item, `ModalDialog` reports that the user selected the item and then exits. Your application is then responsible for performing the appropriate action in relation to that item. Your application typically calls `ModalDialog` repeatedly until the user dismisses the dialog.

The `filterProc` field of the standard alert structure associated with the `StandardAlert` function, the `filterProc` parameter of the `RunStandardAlert` function, and the `modalFilter` parameter of the `ModalDialog` function take a universal procedure pointer to a callback function known as an **event filter function**. The Dialog Manager provides a **standard event filter function**, which is used if `NULL` is passed in the `filterProc` or `modalFilter` parameters or assigned to the `filterProc` field; however, you should supply an application-defined event filter (callback) function for modal and movable modal alerts and dialogs so as to avoid a basic limitation of the standard event filter (callback) function. (See [Event Filter \(Callback\) Functions For Modal and Movable Modal Alerts and Dialogs](#) later in this chapter.)

#### Modeless Dialogs

For modeless dialogs, you can use the function `IsDialogEvent` to determine whether the event occurred while a modeless dialog was the frontmost window and then, optionally, use the function `DialogSelect` to handle the event if it belongs to a modeless dialog. `DialogSelect` is similar to `ModalDialog` except that it returns control after every event, not just events relating to an enabled item. Also, `DialogSelect` does not pass events to an event filter (callback) function.

## Responding to Events in Controls

### Controls and Control Values

For clicks in those types of controls for which you need to determine or change the control's value, your application should use the Control Manager functions `GetControlValue` and `SetControlValue` to get and set the value. When the user clicks on the OK push button, your application should perform whatever action is necessary to reflect to the values returned by the controls.



## Controls That Accept Keyboard Input

Edit text controls and clock controls, which both accept keyboard input, are typically disabled because you generally do not need to be informed every time the user clicks on one of them or types a character. Instead, you simply need to retrieve the text in the edit text control, or the clock's date/time value, when the user clicks the OK push button.

When you use `ModalDialog` (key-down events in edit text controls and clock controls in modal or movable modal dialogs) or `DialogSelect` (key-down events in edit text controls and clock controls in modeless dialogs), keystrokes and mouse actions within those controls are handled automatically. In the case of an edit text control, this means that

- A blinking vertical bar, called the **insertion point caret**, appears when the user clicks the item.
- When the user drags over text or double-clicks a word, that text is highlighted and replaced by whatever the user types.
- Highlighting of text is extended or shortened when the user holds down the Shift key while clicking or dragging.
- Highlighted text, or the character preceding the insertion point caret, is deleted when the user presses the backspace key.
- Highlighted text, or the character following the insertion point caret, is deleted when the user presses the delete key.
- When the user presses the Tab key, the cursor and keyboard focus frame automatically advance to the next edit text control, clock control, or list box (if any) in the item list, wrapping around to the first one if there are no more items.

### Caret Blinking in Edit Text Controls

`ModalDialog` will cause the insertion point caret to blink in edit text controls in modal and movable modal dialogs. On Mac OS 8/9, for edit text controls in a modeless dialog, you should call `IdleControls` in your main event loop's idle processing function. (This is not necessary on Mac OS X because controls on Mac OS X have their own built-in timers.)

`IdleControls` calls the edit text control with an idle event so that the control can call `TEIdle` to make the insertion point caret blink. You should ensure that, when caret blinking is required, the sleep parameter in the `WaitNextEvent` call is set to a value no greater than that returned by `GetCaretTime`.

## Responding to Events in Modal and Movable Modal Alerts

`StandardAlert` and `RunStandardAlert` handle events automatically, calling `ModalDialog` internally.

If the event is a mouse-down anywhere outside the content region of a modal alert, `ModalDialog` emits the system alert sound and gets the next event.

If the event is a mouse-down outside the content region of a movable modal alert and within a window belonging to the application, `ModalDialog` emits the system alert sound and gets the next event. If the mouse-down is not within the content region or a window belonging to the application, `ModalDialog` performs alert dragging (if the mouse-down is within the title bar) or sends the application to the background (if the mouse-down is not within the title bar).

`ModalDialog` is continually called until the user clicks an enabled control, at which time `StandardAlert` and `RunStandardAlert` remove the alert from the screen and return the item number of the selected control. Your application then should respond appropriately.

The standard event filter (callback) function allows users to use the Return or Enter key to achieve the same effect as a click on the default push button. When you write your own event filter (callback) function, you should ensure that that function retains this behavior.

`ModalDialog` passes events inside the alert to your event filter (callback) function *before* handling the event. Your event filter (callback) function thus provides a means to

- Handle events that `ModalDialog` does not handle.
- Override events `ModalDialog` would otherwise handle.

If your event filter (callback) function does not handle an event inside an alert in its own way, `ModalDialog` handles the event as follows:

- For activate or update events, `ModalDialog` activates or updates the alert window.
- For mouse-down events in a trackable control, `TrackControl` is called to track the mouse. If the user releases the mouse button while the cursor is still in the control, the alert is removed and the control's item number is returned.
- For a mouse-down event in a disabled item, or in no item, or if any other event occurs, nothing happens.

## Responding to Events in Modal and Movable Modal Dialogs

Your application should call `ModalDialog` immediately after displaying a modal or movable modal dialog. `ModalDialog` repeatedly handles events inside the dialog until an event involving an enabled item occurs, at which time `ModalDialog` exits, returning the item number. Your application should then respond appropriately. `ModalDialog` should be continually called until the user clicks on the OK, Cancel, or Don't Save push button, at which time your application should close the dialog.

If the event is a mouse-down anywhere outside the content region of a modal dialog, `ModalDialog` emits the system alert sound and gets the next event.

If the event is a mouse-down outside the content region of a movable modal dialog and within a window belonging to the application, `ModalDialog` emits the system alert sound and gets the next event. If the mouse down is not within the content region or a window belonging to the application, `ModalDialog` performs dialog dragging (if the mouse-down is within the title bar) or sends the application to the background (if the mouse-down is not within the title bar).

If your event filter (callback) function does not handle the event, `ModalDialog` handles the event as follows:

- For activate or update events, `ModalDialog` activates or updates the dialog window.
- If the event is a mouse-down while the cursor is in a control that accepts keyboard input (that is, an edit text control or a clock control), `ModalDialog` responds to the mouse activity by either displaying an insertion point or by selecting text in an edit text control or by highlighting the appropriate part of the clock control. Where there is more than one control that accepts keyboard input, `ModalDialog` moves the keyboard focus to that control. If a key-down event occurs and there is an edit text control in the dialog, `ModalDialog` uses `TextEdit` to handle text entry and editing automatically. For an enabled edit text control, `ModalDialog` returns its item number after it receives either the mouse-down or key-down event. (Normally, edit text controls should be disabled.)
- For mouse-down events in a trackable control, `TrackControl` is called to track the mouse. If the user releases the mouse button while the cursor is still in the control, the control's item number is returned.
- If the event is a Tab key key-down event and there is more than one control that accepts keyboard input, `ModalDialog` moves the keyboard focus to the next such item in the item list.
- For a mouse-down event in a disabled item, or in no item, or if any other event occurs, nothing happens.

## Specifying the Events To Be Received by `ModalDialog`

The function `SetModalDialogEventMask` may be used to specify the events to be received by the `ModalDialog` function for a given modal or movable modal dialog. This allows your application to specify additional events that are not by default received by `ModalDialog`, such as operating system events. If you use this function to change the `ModalDialog` function's event mask, you must pass `ModalDialog` a universal procedure pointer to your own event filter (callback) function to handle the added events.

You can ascertain the events to be received by `ModalDialog` by calling `GetModalDialogEventMask`.

## Simulating Item Selection

You can cause the Dialog Manager to simulate item selection in a modal or movable modal dialog using the function `SetDialogTimeout`. You can use this function in circumstances where you wish to start a countdown for a specified duration for a specified dialog. When the specified time elapses, the Dialog Manager simulates a click on the specified button. The Dialog Manager will not simulate item selection until `ModalDialog` processes an event.

You can ascertain the original countdown duration, the time remaining, and the item selection to be simulated by calling `GetDialogTimeout`.

## Event Filter (Callback) Functions for Modal and Movable Modal Alerts and Dialogs

The standard event filter (callback) function dates from the early days of the Macintosh, when a single application controlled the computer. With the introduction of multitasking, however, the standard event filter proved to be somewhat inadequate, its main deficiency being that it does not cater for the updating of either the parent application's windows or those belonging to background applications. (This deficiency is only relevant on Mac OS 8/9.) Your application should therefore provide an application-defined event filter (callback) function that compensates for this inadequacy and handles other events you wish the function to handle.

The standard event filter (callback) function performs the following checks and actions:

- Checks whether the user has pressed the Return or Enter key and, if so, highlights the default push button for eight ticks (Mac OS 8/9 only) and returns the item number of that push button. (Unless informed otherwise, the Dialog Manager assumes that the first item in the item list is the default push button.)
- For dialogs only, and only if the application has previously called certain Dialog Manager functions (see below)
  - Checks whether the user has pressed the Escape key or Command-period and, if so, highlights the Cancel push button for eight ticks (Mac OS 8/9 only) and returns the item number of that button.
  - Check whether the cursor is over an edit text item and, if so, changes the cursor shape to the I-Beam cursor.

As a minimum, your application-defined event filter (callback) function should ensure that these checks and actions are performed and should also

- For Mac OS 8/9 only, handle update events not belonging to the alert or dialog so as to allow the application to update its own windows, and return `false`. (Note that, by responding to update events in the application's own windows in this way, you also allow `ModalDialog` to perform a minor switch when necessary so that background applications can update their windows as well.)
- Return `false` for all events that your event filter (callback) function does not handle.

## Defining an Event Filter (Callback) Function

Part of the recommended approach to defining a basic event filter (callback) function is to continue to use the standard event filter (callback) function to perform its checks and actions as described earlier. This requires certain preliminary action which, for dialogs, requires calls similar to the following examples after the dialog is created and before the call to `ModalDialog`:

```
// Tell the Dialog Manager which is the default push button item, alias the Return and
// Enter keys to that item, and draw the default ring around that item (Mac OS 8/9) or
// make it pulsing blue (Mac OS X).

SetDialogDefaultItem(myDialogRef,iOK);

// Tell the Dialog Manager which is the Cancel push button item, and alias the escape
// key and Command-period key presses to that item.

SetDialogCancelItem(myDialogRef,iCancel);

// Tell the Dialog Manager to track the cursor and change it to the I-Beam cursor shape
// whenever it is over an edit text item.

SetDialogTracksCursor(myDialogRef,true);
```

Note that it is essential that the default and Cancel push buttons, and edit text items, be specified as primitives, not as actual controls, in the 'DLOG' resource.

With those preparations made, you would define your basic event filter (callback) function as in the following example:

```
Boolean myEventFilterFunction(DialogRef dialogRef,EventRecord *eventStrucPtr,
                             SInt16 *itemHit)
{
    Boolean handledEvent;
    GrafPtr oldPort;

    handledEvent = false;

    if((eventStrucPtr->what == updateEvt) &&
        ((WindowRef) eventStrucPtr->message != dialogRef))
    {
        // If the event is an update event, and if it is not for the dialog or alert, call
        // your application's window updating function, and return false.
```

```

    if(!gRunningOnX)
        doUpdate(eventStrucPtr);
    }
    else
    {
        // If the event was not an update, first save the current graphics port and set the
        // alert or dialog's graphics port as the current graphics port. This is
        // necessary when you have called SetDialogTrackCursor to cause the Dialog Manager
        // to track cursor position.

        GetPort(&oldPort);
        SetPortDialogPort(dialogRef);

        // Pass the event to the standard event filter function for handling. If the
        // function handles the event, it will return true and, in the itemHit parameter,
        // the number of the item that it handled. ModalDialog, StandardAlert, and
        // RunStandardAlert then return this item number in their own itemHit parameter.

        handledEvent = StdFilterProc(dialogRef,eventStrucPtr,itemHit);

        // Make the saved graphics port the current graphics port again.

        SetPort(oldPort);
    }

    // Return true or false, as appropriate.

    return(handledEvent);
}

```

StandardAlert, RunStandardAlert, and ModalDialog pass events to your event filter (callback) function *before* handling each event, and will handle the event if your event filter (callback) function returns false.

## NOTE

A major difference between modal alerts and dialogs and movable modal alerts and dialogs is that, in the case of the latter, *all* events are passed to your event filter function for handling. This allows you to, for example, handle suspend and resume events when your application is either moved to the background or brought to the front, as well as other events you might want to handle.

You can also use your event filter (callback) function to handle events that ModalDialog does not handle, such as keyboard equivalents and mouse-down events.



## Responding to Events in Modeless Dialogs

As previously stated, you can use the function `IsDialogEvent` to determine whether an event occurred in a modeless dialog or a document window and then call `DialogSelect` to handle the event if it occurred in a modeless dialog. `DialogSelect` handles the event as follows:

- For activate or update events, `DialogSelect` activates or updates the modeless dialog and returns `false`.
- If the event is a key-down or auto-key event, and there is an edit text item in the modeless dialog, `DialogSelect` uses `TextEdit` to handle text entry and editing and returns `true` and the item number. If there is no edit-text item, `DialogSelect` returns `false`.
- For mouse-downs in an edit text item, `DialogSelect` displays the insertion point caret or selects text as appropriate. `DialogSelect` returns `false` if the edit text item is disabled, and `true` and the item number if it is enabled. (Normally, edit text items should be disabled.)
- For mouse-downs in an enabled trackable control, `DialogSelect` calls `TrackControl` and, if the user releases the mouse button while the cursor is still within the control, returns `true` and the item number.
- For mouse-downs on a disabled item, or in no item, or if any other event occurs, `DialogSelect` does nothing.

In the case of a key-down or auto-key event in an edit text item, you will ordinarily need to filter out Return and Enter key presses and certain Command-key equivalents so that they are not passed to `DialogSelect`. In the case of Return and Enter key presses, you should also highlight the associated push button for eight ticks (for Mac OS 8/9) before calling the function which responds to hits on the OK button. In the case of Command-key presses, you should only allow Command-X, Command-C, and Command-V to be passed to `DialogSelect` (so that `DialogSelect` can support cut, copy, and paste actions within the edit text control) and pass any other Command-key equivalents to your application's menu handling function.

## Closing and Disposing of Dialogs

`CloseDialog` closes the dialog's window and removes it from the screen, and frees up the memory occupied by most types of items in the item list and related data structures. It does not release the memory occupied by the dialog object or item list.

`DisposeDialog` closes the dialog's window and deletes it from the window list, and releases the memory occupied by the dialog object, item list, and most types of items. (Handles leading to icons and pictures are not released.)



For modeless dialogs, you might find it more efficient to hide the dialog with `HideWindow` rather than dispose of the dialog. In that way, the dialog will remain available, and in the same location and with the same settings as when it was last used.

## Creating Displaying and Handling Window-Modal (Sheet) Alerts and Dialogs

### Window-Modal (Sheet) Alerts

Window-modal (sheet) alerts are created using the function `CreateStandardSheet`:

```
OSStatus CreateStandardSheet(AlertType alertType, CFStringRef error,
                             CFStringRef explanation,
                             const AlertStdCFStringAlertParamRec *param,
                             EventTargetRef notifyTarget, DialogRef *outSheet);
```

`alertType` The level of the alert. Relevant constants are

```
kAlertStopAlert
kAlertNoteAlert
kAlertCautionAlert
kAlertPlainAlert
```

`error` The message text.

`explanation` The informative text.

`param` A pointer to a **standard CFString alert parameter structure** (see above). NULL indicates that none of the features provided by the standard alert structure are required.

`notifyTarget` The event target to be notified when the sheet is closed.

`outSheet` On return, the sheet's dialog reference.

The sheet will be invisible when created. A call to `ShowSheetWindow` displays the sheet.

If the sheet has more than one button, your application will need to determine which button was hit by the user. This requires the use of the Carbon event model and the installation of an event handler on the event target (see Chapter 17). The event target is ordinarily the owner window, in which case you pass a reference to that window in a call to `GetWindowEventTarget` and pass the returned event target reference in the `notifyTarget` parameter of `CreateStandardSheet`. The Carbon event handler you install should respond to the `kEventProcessCommand` Carbon event type and should test for the command IDs `kHICCommandOK`, `kHICCommandCancel`, and `kHICCommandOther` in order to determine which button was hit.

If the sheet has only one button (an OK button), you can simply pass the returned event target reference in the `notifyTarget` parameter (so that the `CreateStandardSheet` call will not fail) and not install a handler. The sheet will be dismissed when the button is hit.

## Window-Modal (Sheet) Dialogs

Window-modal (sheet) dialogs, like other dialogs, may be created using `GetNewDialog` or `NewFeaturesDialog`. The window definition ID should be `kWindowSheetProc (1088)` and the dialog should be created invisible.

A call to `ShowSheetWindow` displays the sheet. Your application should ensure that only one sheet is displayed in a window at one time.

Events in window-modal (sheet) dialogs may be handled in the same way as for modeless dialogs.

## Balloon Help for Dialogs—Mac OS 8/9

Two basic options are available for adding help balloons to dialogs for Mac OS 8/9:

- Adding a **balloon help item** to the item list ('DITL') resource, which will associate either a **rectangle help** ('hrcr') resource or a **dialog help** ('hdlg') resource with that 'DITL' resource. Each hot rectangle component in the 'hrcr' resource, and each dialog item component in the 'hdlg' resource, corresponds to an item number in the 'DITL' resource.
- Supplying a window help ('hwin') resource, which will associate help balloons defined in either 'hrcr' resources or 'hdlg' resources with the dialog's window.

### NOTE

'hrcr' and 'hwin' resources are described in Chapter 4.

The option of using a balloon help item (usually referred to as simply a “help item”) overcomes the major limitation of the 'hwin' resource methodology, which is the inability to adequately differentiate between dialogs with no titles (see Chapter 4—Windows, Fig 14). On the other hand, adopting the help item methodology means that you can only associate help balloons with items in the 'DITL' resource; you cannot provide a single help balloon for a group of related items (unless, of course, they are grouped within a primary or secondary group box).

Help items are invisible. In Resorcerer, the presence of a balloon help item in a 'DITL' resource is indicated only by a checkmark in the Balloon Help... item in the Item menu. A help item's presence in the 'DITL' resource is completely ignored by the Dialog Manager.

When the help item methodology is used, the Help Manager automatically tracks the cursor and displays help balloons when the following conditions are met: the dialog has a help item in its 'DITL' resource; your application calls the Dialog Manager functions `ModalDialog`, or `IsDialogEvent`; balloon help is enabled.

Figs 13 and 14 in Chapter 4 show 'hrcr' and 'hwin' resources being created using Resorcerer. Figs 13 and 14 below show a help item and a 'hdlg' (dialog help) resource being created using Resorcerer.

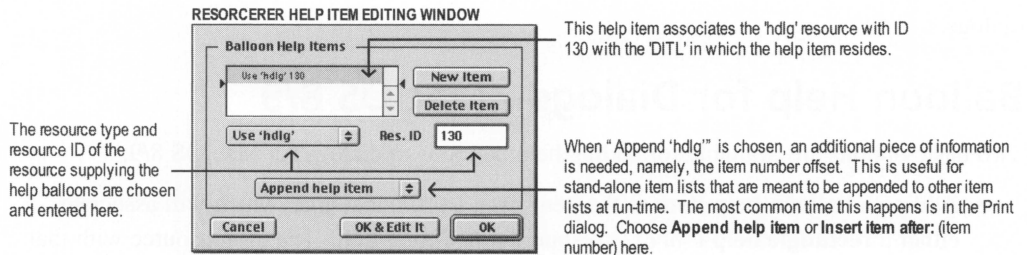


FIG 13 - CREATING A HELP ITEM USING RESORCERER

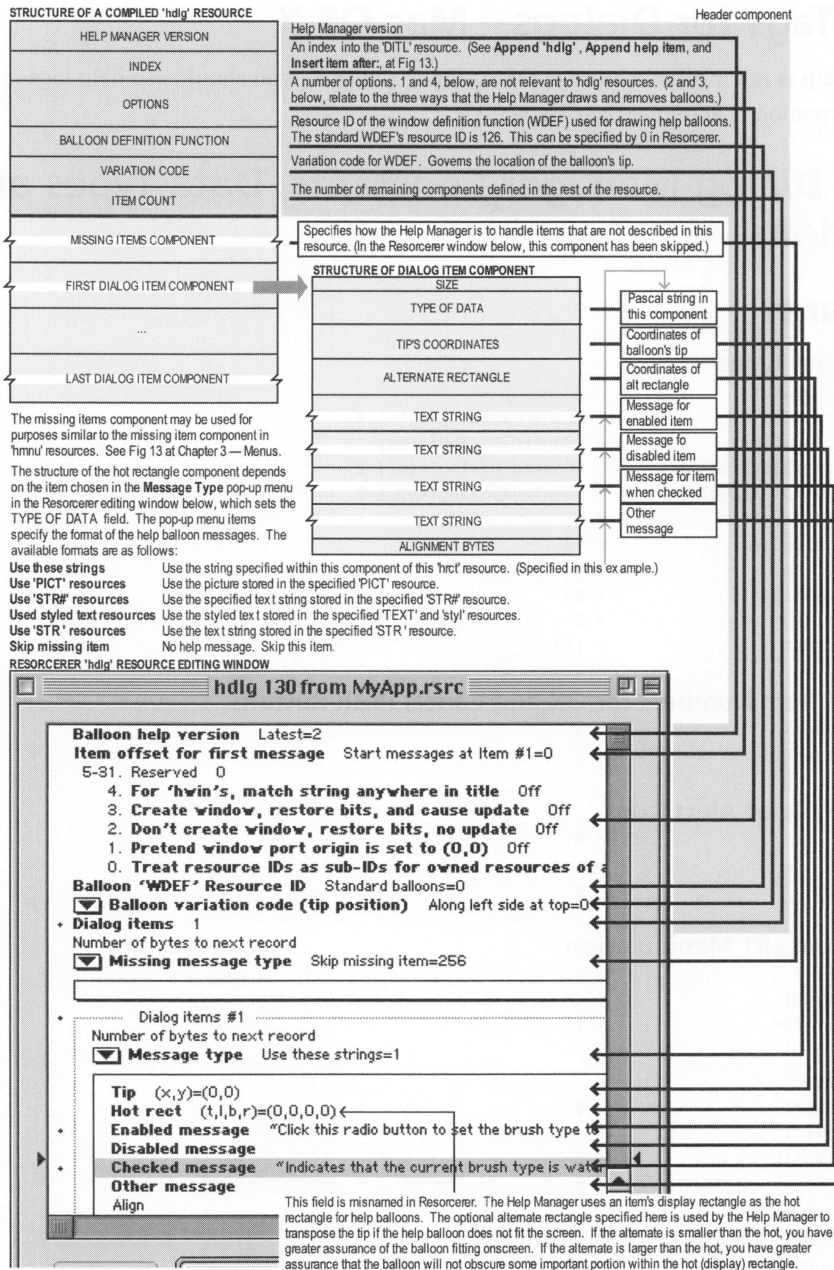


FIG 14 • CREATING A 'hdlg' RESOURCE USING RESORCERER

## Help Tags for Dialogs—Mac OS X

Balloon help is not available on Mac OS X. On Mac OS X, you should use help tags instead. Help tag creation is addressed in Chapter 25.

## Main Dialog Manager Constants, Data Types and Functions

### Constants

#### Dialog Item Types

kControlDialogItem	= 4
kButtonDialogItem	= kControlDialogItem   0
kCheckBoxDialogItem	= kControlDialogItem   1
kRadioButtonDialogItem	= kControlDialogItem   2
kResourceControlDialogItem	= kControlDialogItem   3
kStaticTextDialogItem	= 8
kEditTextDialogItem	= 16
kIconDialogItem	= 32
kPictureDialogItem	= 64
kUserDialogItem	= 0
kItemDisableBit	= 128

#### Standard Item Numbers for OK and Cancel Push Buttons

KStdOKItemIndex	= 1
KStdCancelItemIndex	= 2

#### Resource IDs of Alert Icons

kStopIcon	= 0
kNoteIcon	= 1
kCautionIcon	= 2

#### Dialog Item List Manipulation

overlayDITL	= 0
appendDITLRight	= 1
appendDITLBottom	= 2

#### Alert Types

kAlertStopAlert	= 0
kAlertNoteAlert	= 1
kAlertCautionAlert	= 2
kAlertPlainAlert	= 3

#### Standard Alert Push Button Numbers

kAlertStdAlertOKButton	= 1
kAlertStdAlertCancelButton	= 2
kAlertStdAlertOtherButton	= 3
kAlertStdAlertHelpButton	= 4

## Alert Default Text

```
kAlertDefaultOKText      = -1
kAlertDefaultCancelText  = -1
kAlertDefaultOtherText   = -1
```

## Dialog Feature Flags

```
kDialogFlagsUseThemeBackground = (1 << 0)
kDialogFlagsUseControlHierarchy = (1 << 1)
kDialogFlagsHandleMovableModal = (1 << 2)
kDialogFlagsUseThemeControls   = (1 << 3)
```

## Dialog Font Flags

```
kDialogFontNoFontStyle      = 0
kDialogFontUseFontMask      = 0x0001
kDialogFontUseFaceMask      = 0x0002
kDialogFontUseSizeMask      = 0x0004
kDialogFontUseForeColorMask = 0x0008
kDialogFontUseBackColorMask = 0x0010
kDialogFontUseModeMask      = 0x0020
kDialogFontUseJustMask      = 0x0040
kDialogFontUseAllMask       = 0x00FF
kDialogFontAddFontSizeMask  = 0x0100
kDialogFontUseFontNameMask  = 0x0200
```

## Constants Used in NewFeaturesDialog inProcID Parameter

```
kWindowDocumentProc      = 1024  Modeless dialog
kWindowPlainDialogProc    = 1040  Modal dialog
kWindowShadowDialogProc   = 1041  Modal dialog
kWindowModalDialogProc    = 1042  Modal dialog
kWindowMovableModalDialogProc = 1043 Movable modal dialog
kWindowAlertProc          = 1044  Modal alert
kWindowMovableAlertProc   = 1045  Movable modal alert
```

## Data Types

```
typedef struct OpaqueDialogPtr *DialogPtr;
typedef DialogPtr DialogRef;
```

## Standard Alert Parameter Structure

```
struct AlertStdAlertParamRec
{
    Boolean      movable;
    Boolean      helpButton;
    ModalFilterUPP filterProc;
    ConstStringPtr defaultText;
    ConstStringPtr cancelText;
    ConstStringPtr otherText;
    SInt16       defaultButton;
    SInt16       cancelButton;
    UInt16       position;
};
typedef struct AlertStdAlertParamRec AlertStdAlertParamRec;
typedef AlertStdAlertParamRec *AlertStdAlertParamPtr;
```

## Standard CFStringAlert Alert Parameter Structure

```
struct AlertStdCFStringAlertParamRec
{
    UInt32      version;
    Boolean     movable;
    Boolean     helpButton;
    CFStringRef defaultText;
    CFStringRef cancelText;
    CFStringRef otherText;
    SInt16      defaultButton;
    SInt16      cancelButton;
    UInt16      position;
    OptionBits  flags;
};
typedef struct AlertStdCFStringAlertParamRec AlertStdCFStringAlertParamRec;
typedef AlertStdCFStringAlertParamRec *AlertStdCFStringAlertParamPtr;
```

## Functions

### Creating Alerts

```
OSErr      StandardAlert(AlertType inAlertType, ConstStr255Param inError,
                        ConstStr255Param inExplanation, const AlertStdAlertParamPtr inAlertParam,
                        SInt16 *outItemHit);
OSStatus    CreateStandardAlert(AlertType alertType, CFStringRef error, CFStringRef explanation,
                                const AlertStdCFStringAlertParamRec *param, DialogRef outAlert);
OSStatus    RunStandardAlert(DialogRef inAlert, ModalFilterUPP filterProc,
                              DialogItemIndex *outItemHit);
OSStatus    GetStandardAlertDefaultParams(AlertStdCFStringAlertParamPtr param, UInt32 version);
```

### Creating, Closing, and Disposing of Dialogs

```
DialogRef    GetNewDialog(short dialogID, void *dStorage, WindowRef behind);
DialogRef    NewFeaturesDialog(void *inStorage, const Rect *inBoundsRect,
                                ConstStr255Param inTitle, Boolean inIsVisible, SInt16 inProcID, WindowRef inBehind,
                                Boolean inGoAwayFlag, SInt32 inRefCon, Handle inItemListHandle, UInt32 inFlags);
OSErr        AutoSizeDialog(DialogRef inDialog);
void         CloseDialog(DialogRef theDialog);
void         DisposeDialog(DialogRef theDialog);
```

### Creating Sheets (Mac OS X Only)

```
OSStatus    CreateStandardSheet(AlertType alertType, CFStringRef error, CFStringRef explanation,
                                const AlertStdCFStringAlertParamRec *param, EventTargetRef notifyTarget,
                                DialogRef *outSheet);
```

### Dialog Object Accessor Functions

```
WindowRef    GetDialogWindow(DialogRef dialog);
TEHandle     GetDialogTextEditHandle(DialogRef dialog);
SInt16       GetDialogKeyboardFocusItem(DialogRef dialog);
SInt16       GetDialogDefaultItem(DialogRef dialog);
OSErr        SetDialogDefaultItem(DialogRef theDialog, DialogItemIndex newItem);
SInt16       GetDialogCancelItem(DialogRef dialog);
OSErr        SetDialogCancelItem(DialogRef theDialog, DialogItemIndex newItem);
```



## Utility and Casting Functions

```
void      SetPortDialogPort(DialogRef dialog);
CGrafPtr  GetDialogPort(DialogRef dialog);
DialogRef GetDialogFromWindow(WindowRef window);
```

## Manipulating Items in Alerts and Dialogs

```
void      GetDialogItem(DialogRef theDialog,short itemNo,short *itemType,Handle *item,
                      Rect *box);
void      SetDialogItem(DialogRef theDialog,short itemNo,short itemType,Handle item,
                      const Rect *box);
OSErr     GetDialogItemAsControl(DialogRef inDialog,SInt16 inItemNo,
                      ControlHandle *outControl);
OSErr     MoveDialogItem(DialogRef inDialog,SInt16 inItemNo,SInt16 inHoriz,SInt16 inVert);
OSErr     SizeDialogItem(DialogRef inDialog,SInt16 inItemNo,SInt16 inHeight,SInt16 inWidth);
void      HideDialogItem(DialogRef theDialog,short itemNo);
void      ShowDialogItem(DialogRef theDialog,short itemNo);
short     FindDialogItem(DialogRef theDialog,Point thePt);
void      AppendDITL(DialogRef theDialog,Handle theHandle,DITLMethod theMethod);
void      ShortenDITL(DialogRef theDialog,short numberItems);
OSErr     AppendDialogItemList(DialogRef dialog,SInt16 ditlID,DITLMethod method);
short     CountDITL(DialogRef theDialog);
OSStatus  InsertDialogItem (DialogRef theDialog,DialogItemIndex afterItem,
                      DialogItemType itemType,Handle itemHandle,const Rect *box);
OSStatus  RemoveDialogItems(DialogRef theDialog,DialogItemIndex itemNo,
                      DialogItemIndex amountToRemove,Boolean disposeItemData);
```

## Handling Text in Alerts and Dialogs

```
void      ParamText(ConstStr255Param param0,ConstStr255Param param1,ConstStr255Param param2,
                      ConstStr255Param param3);
void      GetParamText(StringPtr param0,StringPtr param1,StringPtr param2,StringPtr param3);
void      GetDialogItemText(Handle item,Str255 text)
void      SetDialogItemText(Handle item,ConstStr255Param text);
void      SelectDialogItemText(DialogRef theDialog,short itemNo,short strtSel,short endSel);
void      SetDialogFont(short value);
void      DialogCut(DialogRef theDialog);
void      DialogPaste(DialogRef theDialog);
void      DialogCopy(DialogRef theDialog);
void      DialogDelete(DialogRef theDialog);
```

## Handling Events in Dialogs

```
void      ModalDialog(ModalFilterUPP modalFilter,short *itemHit);
Boolean   IsDialogEvent(const EventRecord *theEvent);
Boolean   DialogSelect(const EventRecord *theEvent,DialogRef *theDialog,short *itemHit);
void      UpdateDialog(DialogRef theDialog,RgnHandle updateRgn);
void      DrawDialog(DialogRef theDialog);
OSStatus  SetModalDialogEventMask(DialogRef inDialog,EventMask inMask);
OSStatus  GetModalDialogEventMask(DialogRef inDialog,EventMask *outMask);
OSStatus  SetDialogTimeout(DialogRef inDialog,SInt16 inButtonToPress,UInt32 inSecondsToWait);
OSStatus  GetDialogTimeout(DialogRef inDialog,SInt16 *outButtonToPress,
                      UInt32 *outSecondsToWait,UInt32 *outSecondsRemaining);
Boolean   StdFilterProc(DialogRef theDialog,EventRecord *event,DialogItemIndex *itemHit);
OSErr     GetStdFilterProc(ModalFilterUPP *theProc);
OSErr     SetDialogDefaultItem(DialogRef theDialog,DialogItemIndex newItem);
OSErr     SetDialogCancelItem(DialogRef theDialog,DialogItemIndex newItem);
OSErr     SetDialogTracksCursor(DialogRef theDialog,Boolean tracks);
```

## Creating and Disposing of Universal Procedure Pointers for Event Filter (Callback) Functions

```
ModalFilterUPP NewModalFilterUPP(ModalFilterProcPtr userRoutine);
void DisposeModalFilterUPP(ModalFilterUPP userUPP);
```

## Application-Defined (Callback) Function

```
Boolean myModalFilterFunction(DialogRef theDialog, EventRecord *theEvent,
    DialogItemIndex *itemHit);
```

## Relevant Window Manager Functions (Mac OS X Only)

### Showing and Hiding Sheets

```
OSStatus ShowSheetWindow(WindowRef inSheet, WindowRef inParentWindow);
OSStatus HideSheetWindow(WindowRef inSheet);
OSStatus GetSheetWindowParent(WindowRef inSheet, WindowRef *outParentWindow);
```

## Demonstration Program DialogAndAlerts Listing

```
// *****
// DialogsAndAlerts.h CLASSIC EVENT MODEL
// *****
//
// This program initially opens a small modal dialog which is automatically closed after 10
// seconds, the timeout value having been set by a call to SetDialogTimeout. The program
// then:
//
// • Opens a window for the purposes of displaying advisory text and proving correct window
//   updating and activation/deactivation in the presence of alerts and dialogs.
//
// • Allows the user to invoke, via the Demonstration menu, modal and movable modal alerts
//   and dialogs, a modeless dialog and, on Mac OS X, a window-modal alert and dialog
//   (i.e., sheets).
//
// The modal alert box is created programmatically using the StandardAlert function.
//
// The movable modal alert is created programmatically using the StandardAlert function on Mac
// OS 9 and the CreateStandardAlert function on Mac OS X.
//
// The modal dialog contains three checkboxes in one group box, and two pop-up menu buttons in
// another group box.
//
// The movable modal dialog contains four radio buttons in one group box, and a clock control
// and edit text item in another group box.
//
// The modeless dialog contains, amongst other items, an edit text item.
//
// The modal and movable modal alerts and dialogs use an application-defined event filter
// (callback) function.
//
// The program utilises the following resources:
//
```

```

// • A 'plst' resource.
//
// • An 'MBAR' resource, and 'MENU' resources for Apple, File, and Demonstration pull-down
// menus, and the pop-up menu buttons (preload, non-purgeable).
//
// • A 'WIND' resource (purgeable) (initially visible).
//
// • 'DLOG' resources (purgeable) (initially not visible) and associated 'DITL' resources
// (purgeable), 'dlgx' resources (purgeable), and 'dftb' resources (non-purgeable, but
// 'dftb' resources are automatically marked purgeable when read in).
//
// • 'CNTL' resources for primary group boxes, separator lines, pop-up menu buttons, a clock,
// and an image well (all purgeable).
//
// • 'STR#' resources (purgeable) containing the message and informative text for the alerts.
//
// • A 'cicn' resource (purgeable) for the modeless dialog box.
//
// • A 'ppat' resource (purgeable), which is used to color the content region of the
// document window for update proving purposes.
//
// • 'hdlg' resources (purgeable) containing balloon help information for the modal and
// movable modal dialog.
//
// • An 'hrcr' resource and associated 'hwin' resource (both purgeable) containing balloon
// help information for the modeless dialog.
//
// • A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
// doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenuBar                128
#define mAppleApplication      128
#define iAbout                  1
#define mFile                   129
#define iClose                   4
#define iQuit                    12
#define mEdit                   130
#define iCut                      3
#define iCopy                     4
#define iPaste                    5
#define iClear                    6
#define mDemonstration          131
#define iModalAlert              1
#define iMovableAlert            2
#define iModalDialog             3
#define iMovableModalDialog      4
#define iModeless                5

```

```

#define iWindowModalAlert      7
#define iWindowModalDialog    8
#define mFont                  132
#define rWindow                128
#define rSplash                128
#define rModalDialog          129
#define iGridSnap              4
#define iShowGrid              5
#define iShowRulers            6
#define iFont                  11
#define iSound                 12
#define rMovableModalDialog    130
#define iCharcoal              7
#define iOilPaint              8
#define iPencil                9
#define iChalk                 10
#define iClockOne              12
#define rModelessDialog        131
#define iEditTextSearchModeless 2
#define rSheetDialog           132
#define iEditTextSheetDialog   2
#define rAlertStrings          128
#define sModalMessage          1
#define sModalInformative      2
#define sMovableMessage        3
#define sMovableInformative    4
#define rSheetStrings          132
#define sAlertSheetMessage     1
#define sAlertSheetInformative 2
#define rPixelPattern          128
#define kSearchModeless        1
#define kSheetDialog           2

#define kReturn                (SInt8) 0x0D
#define kEnter                 (SInt8) 0x03
#define kEscape                (SInt8) 0x1B
#define kPeriod                (SInt8) 0x2E

#define MAX_UINT32              0xFFFFFFFF

// ..... function prototypes

void    main                                (void);
void    doPreliminaries                    (void);
OSErr   quitAppEventHandler                (AppleEvent *,AppleEvent *,SInt32);
void    eventLoop                          (void);
void    doIdle                             (void);
void    doEvents                           (EventRecord *);
void    doMouseDown                        (EventRecord *);
void    doKeyDown                          (EventRecord *);
void    doUpdate                           (EventRecord *);
void    doUpdateDocument                   (WindowRef);
void    doActivate                         (EventRecord *);
void    doActivateDocument                 (WindowRef,Boolean);
void    doActivateDialogs                  (EventRecord *,Boolean);

```

```

void    doOSEvent                (EventRecord *);
void    doAdjustMenus            (void);
void    doMenuChoice             (SInt32);
void    doEditMenu               (MenuItemIndex);
void    doDemonstrationMenu      (MenuItemIndex);
void    doExplicitlyDeactivateDocument (void);
Boolean doModalAlerts            (Boolean);
Boolean doMovableModalAlertOnX   (void);
Boolean doModalDialog            (void);
Boolean doMovableModalDialog     (void);
Boolean doCreateOrShowModelessDialog (void);
void    doInContent              (EventRecord *);
void    doButtonHitInSearchModeless (void);
void    doHideModelessDialog     (WindowRef);
Boolean eventFilter              (DialogRef, EventRecord *, SInt16 *);
void    doPopupMenuChoice        (ControlRef, SInt16);
void    doDrawMessage            (WindowRef, Boolean);
void    doCopyPString            (Str255, Str255);

Boolean doSheetAlert             (void);
Boolean doSheetDialog            (void);
void    doButtonHitInSheetDialog (void);

void    helpTagsModal            (DialogRef);
void    helpTagsMovableModal     (DialogRef);
void    helpTagsModeless         (DialogRef);

// *****
// DialogsAndAlerts.c
// *****

// ..... includes

#include "DialogsAndAlerts.h"

// ..... global variables

Boolean    gRunningOnX           = false;
ModalFilterUPP gEventFilterUPP;
Str255      gCurrentString;
WindowRef   gWindowRef;
SInt32      gSleepTime;
Boolean     gDone;
Boolean     gGridSnap            = kControlCheckBoxUncheckedValue;
Boolean     gShowGrid            = kControlCheckBoxUncheckedValue;
Boolean     gShowRule            = kControlCheckBoxUncheckedValue;
SInt16      gBrushType           = iCharcoal;
DialogRef   gModelessDialogRef = NULL;

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;

```

```

MenuRef      menuRef;
DialogRef    dialogRef;
SInt16       itemHit;

// ..... do preliminaries

doPreliminaries();

// ..... set up menu bar and menus

menubarHdl = GetNewMBar(rMenubar);
if(menubarHdl == NULL)
    ExitToShell();
SetMenuBar(menubarHdl);
DrawMenuBar();

Gestalt(gestaltMenuMgrAttr,&response);
if(response & gestaltMenuMgrAquaLayoutMask)
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
    {
        DeleteMenuItem(menuRef,iQuit);
        DeleteMenuItem(menuRef,iQuit - 1);
        DisableMenuItem(menuRef,0);
    }

    gRunningOnX = true;
}

// ..... open small modal dialog and automatically dismiss it after 10 seconds

dialogRef = GetNewDialog(rSplash,NULL,(WindowRef) -1);
SetDialogTimeout(dialogRef,kStdOkItemIndex,10);

do
{
    ModalDialog(NULL,&itemHit);
} while(itemHit != kStdOkItemIndex);

DisposeDialog(dialogRef);

// ..... create universal procedure pointer for event filter function

gEventFilterUPP = NewModalFilterUPP((ModalFilterProcPtr) eventFilter);

// ..... initial advisory text for window header

doCopyPString("\pBalloon (OS 8/9) and Help tag (OS X) help is available",gCurrentString);

// ..... open a window, set font size

if(!(gWindowRef = GetNewCWindow(rWindow,NULL,(WindowRef)-1)))
    ExitToShell();

```

```

SetPortWindowPort(gWindowRef);
if (!gRunningOnX)
    TextSize(10);

// ..... enter eventLoop
eventLoop();
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    OSErr osError;

    MoreMasterPointers(192);
    InitCursor();
    FlushEvents(everyEvent,0);

    osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
                                   NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
                                   0L,false);

    if (osError != noErr)
        ExitToShell();
}

// ***** doQuitAppEvent

OSErr quitAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,SInt32 handlerRefcon)
{
    OSErr osError;
    DescType returnedType;
    Size actualSize;

    osError = AEGetAttributePtr(appEvent,keyMissedKeywordAttr,typeWildCard,&returnedType,NULL,0,
                                &actualSize);

    if (osError == errAEDescNotFound)
    {
        gDone = true;
        osError = noErr;
    }
    else if (osError == noErr)
        osError = errAEParamMissed;

    return osError;
}

// ***** eventLoop

void eventLoop(void)
{
    EventRecord eventStructure;
    Boolean gotEvent;

```



```

gSleepTime = MAX_UINT32;
gDone = false;

while(!gDone)
{
    gotEvent = WaitNextEvent(everyEvent,&eventStructure,gSleepTime,NULL);
    if(gotEvent)
        doEvents(&eventStructure);
    else
    {
        if(eventStructure.what == nullEvent)
            if(!gRunningOnX)
                doIdle();
    }
}
}

// ***** doIdle

void doIdle(void)
{
    if(FrontWindow() == GetDialogWindow(gModelessDialogRef))
        IdleControls(GetDialogWindow(gModelessDialogRef));
}

// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEPProcessAppleEvent(eventStrucPtr);
            break;

        case mouseDown:
            doMouseDown(eventStrucPtr);
            break;

        case keyDown:
            doKeyDown(eventStrucPtr);
            break;

        case autoKey:
            if((eventStrucPtr->modifiers & cmdKey) == 0)
                doKeyDown(eventStrucPtr);
            break;

        case updateEvt:
            doUpdate(eventStrucPtr);
            break;

        case activateEvt:
            doActivate(eventStrucPtr);
            break;
    }
}

```

```

    case osEvt:
        doOSEvent(eventStrucPtr);
        break;
}
}

// ***** doMouseDown

void doMouseDown(EventRecord *eventStrucPtr)
{
    WindowRef    windowRef;
    WindowPartCode partCode;

    partCode = FindWindow(eventStrucPtr->where,&windowRef);

    switch(partCode)
    {
        case inMenuBar:
            doAdjustMenus();
            doMenuChoice(MenuSelect(eventStrucPtr->where));
            break;

        case inContent:
            if(windowRef != FrontWindow())
                SelectWindow(windowRef);
            else
                doInContent(eventStrucPtr);
            break;

        case inDrag:
            DragWindow(windowRef,eventStrucPtr->where,NULL);
            break;

        case inGoAway:
            if(TrackGoAway(windowRef,eventStrucPtr->where))
            {
                if(GetWindowKind(windowRef) == kDialogWindowKind)
                {
                    doHideModelessDialog(windowRef);
                    doCopyPString("\pBalloon (OS 8/9) and Help tag (OS X) help is available",
                                gCurrentString);
                }
            }
            break;
    }
}

// ***** doKeyDown

void doKeyDown(EventRecord *eventStrucPtr)
{
    WindowRef    windowRef;
    SInt8        charCode;
    SInt32        windowRefCon;
    SInt16        itemHit;

```

```

ControlRef controlRef;
UInt32      finalTicks;
DialogRef   dialogRef;

windowRef = FrontWindow();
charCode = eventStrucPtr->message & charCodeMask;

if(!IsDialogEvent(eventStrucPtr))
{
    if((eventStrucPtr->modifiers & cmdKey) != 0)
    {
        doAdjustMenus();
        doMenuChoice(MenuEvent(eventStrucPtr));
    }
}
else
{
    windowRefCon = GetWRefCon(windowRef);
    if(windowRefCon == kSearchModeless || windowRefCon == kSheetDialog)
    {
        if((charCode == kReturn) || (charCode == kEnter))
        {
            GetDialogItemAsControl(GetDialogFromWindow(windowRef), kStdOkItemIndex, &controlRef);
            HiliteControl(controlRef, kControlButtonPart);
            Delay(8, &finalTicks);
            HiliteControl(controlRef, kControlEntireControl);
            if(windowRefCon == kSearchModeless)
                doButtonHitInSearchModeless();
            else if(windowRefCon == kSheetDialog)
                doButtonHitInSheetDialog();
            return;
        }

        if((eventStrucPtr->modifiers & cmdKey) != 0)
        {
            if(charCode == 'X' || charCode == 'x' || charCode == 'C' || charCode == 'c' ||
               charCode == 'V' || charCode == 'v')
            {
                HiliteMenu(mEdit);
                DialogSelect(eventStrucPtr, &dialogRef, &itemHit);
                Delay(4, &finalTicks);
                HiliteMenu(0);
            }
            else
            {
                doAdjustMenus();
                doMenuChoice(MenuEvent(eventStrucPtr));
            }

            return;
        }

        DialogSelect(eventStrucPtr, &dialogRef, &itemHit);
    }
}
}

```

```
// ***** doUpdate

void doUpdate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    DialogRef dialogRef;
    SInt16 itemHit;

    if(!IsDialogEvent(eventStrucPtr))
    {
        windowRef = (WindowRef) eventStrucPtr->message;
        doUpdateDocument(windowRef);
    }
    else
        DialogSelect(eventStrucPtr,&dialogRef,&itemHit);
}

// ***** doUpdateDocument

void doUpdateDocument(WindowRef windowRef)
{
    GrafPtr oldPort;
    PixPatHandle pixpatHdl;
    Rect portRect;

    BeginUpdate(windowRef);

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    pixpatHdl = GetPixPat(rPixelPattern);
    GetWindowPortBounds(windowRef,&portRect);
    FillCRect(&portRect,pixpatHdl);
    DisposePixPat(pixpatHdl);
    doDrawMessage(windowRef,windowRef == FrontWindow());

    SetPort(oldPort);

    EndUpdate(windowRef);
}

// ***** doActivate

void doActivate(EventRecord *eventStrucPtr)
{
    Boolean becomingActive;
    WindowRef windowRef;

    becomingActive = (eventStrucPtr->modifiers & activeFlag) == activeFlag;

    if(!IsDialogEvent(eventStrucPtr))
    {
        windowRef = (WindowRef) eventStrucPtr->message;
        doActivateDocument(windowRef,becomingActive);
    }
}
```

```

    else
        doActivateDialogs(eventStrucPtr, becomingActive);
}

// ***** doActivateDocument

void doActivateDocument(WindowRef windowRef, Boolean becomingActive)
{
    if(becomingActive)
        doAdjustMenus();

    doDrawMessage(windowRef, becomingActive);
}

// ***** doActivateModelessDialog

void doActivateDialogs(EventRecord *eventStrucPtr, Boolean becomingActive)
{
    DialogRef dialogRef;
    SInt16 windowRefCon;
    SInt16 itemHit;

    DialogSelect(eventStrucPtr, &dialogRef, &itemHit);

    windowRefCon = GetWRefCon(GetDialogWindow(dialogRef));

    if(becomingActive)
    {
        doAdjustMenus();
        if(windowRefCon == kSearchModeless || windowRefCon == kSheetDialog)
            gSleepTime = GetCaretTime();
    }
    else
    {
        if(windowRefCon == kSearchModeless || windowRefCon == kSheetDialog)
            gSleepTime = MAX_UINT32;
    }
}

// ***** doOSEvent

void doOSEvent(EventRecord *eventStrucPtr)
{
    switch((eventStrucPtr->message >> 24) & 0x000000FF)
    {
        case suspendResumeMessage:
            if((eventStrucPtr->message & resumeFlag) == 1)
                SetThemeCursor(kThemeArrowCursor);
            break;
    }
}

```

```
// ***** doAdjustMenus

void doAdjustMenus(void)
{
    WindowRef windowRef;
    MenuRef menuRef;
    SInt32 windowRefCon;

    windowRef = FrontWindow();

    if(GetWindowKind(windowRef) == kApplicationWindowKind)
    {
        menuRef = GetMenuRef(mFile);
        DisableMenuItem(menuRef, iClose);
        menuRef = GetMenuRef(mEdit);
        DisableMenuItem(menuRef, 0);
        menuRef = GetMenuRef(mDemonstration);
        EnableMenuItem(menuRef, iModeless);
        if(gRunningOnX)
        {
            if(IsWindowCollapsed(gWindowRef))
            {
                DisableMenuItem(menuRef, iWindowModalDialog);
                DisableMenuItem(menuRef, iWindowModalAlert);
            }
            else
            {
                EnableMenuItem(menuRef, iWindowModalDialog);
                EnableMenuItem(menuRef, iWindowModalAlert);
            }
        }
    }
    else if(GetWindowKind(windowRef) == kDialogWindowKind)
    {
        windowRefCon = GetWRefCon(windowRef);
        if(windowRefCon == kSearchModeless)
        {
            menuRef = GetMenuRef(mFile);
            EnableMenuItem(menuRef, iClose);
            menuRef = GetMenuRef(mEdit);
            EnableMenuItem(menuRef, 0);
            menuRef = GetMenuRef(mDemonstration);
            DisableMenuItem(menuRef, iModeless);
        }
        else if(windowRefCon == kSheetDialog)
        {
            menuRef = GetMenuRef(mFile);
            DisableMenuItem(menuRef, iClose);
            menuRef = GetMenuRef(mEdit);
            EnableMenuItem(menuRef, 0);
            menuRef = GetMenuRef(mDemonstration);
            EnableMenuItem(menuRef, iModeless);
            DisableMenuItem(menuRef, iWindowModalAlert);
        }
    }
}
```

```

        else
        {
            menuRef = GetMenuRef(mFile);
            DisableMenuItem(menuRef, iClose);
            menuRef = GetMenuRef(mEdit);
            DisableMenuItem(menuRef, 0);
            menuRef = GetMenuRef(mDemonstration);
            EnableMenuItem(menuRef, iModeless);
        }
    }

    DrawMenuBar();
}

// ***** doMenuChoice

void doMenuChoice(SInt32 menuChoice)
{
    MenuID      menuID;
    MenuItemIndex menuItem;
    SInt16      windowRefCon;

    menuID = HiWord(menuChoice);
    menuItem = LoWord(menuChoice);

    if(menuID == 0)
        return;

    switch(menuID)
    {
        case mAppleApplication:
            if(menuItem == iAbout)
                SysBeep(10);
            break;

        case mFile:
            if(menuItem == iQuit)
                gDone = true;
            else if(menuItem == iClose)
            {
                if(GetWindowKind(FrontWindow()) == kDialogWindowKind)
                {
                    windowRefCon = GetWRefCon(FrontWindow());
                    if(windowRefCon == kSearchModeless)
                        doHideModelessDialog(GetDialogWindow(gModelessDialogRef));
                }
            }
            break;

        case mEdit:
            doEditMenu(menuItem);
            break;
    }
}

```



```

        case mDemonstration:
            doDemonstrationMenu(menuItem);
            break;
    }

    HiliteMenu(0);
}

// ***** doEditMenu

void doEditMenu(MenuBarItem menuItem)
{
    WindowRef windowRef;
    SInt16 windowRefCon;
    DialogRef dialogRef;

    windowRef = FrontWindow();

    if(GetWindowKind(FrontWindow()) == kDialogWindowKind)
    {
        windowRefCon = GetWRefCon(windowRef);
        if(windowRefCon == kSearchModeless || windowRefCon == kSheetDialog)
        {
            dialogRef = GetDialogFromWindow(windowRef);

            switch(menuItem)
            {
                case iCut:
                    DialogCut(dialogRef);
                    break;

                case iCopy:
                    DialogCopy(dialogRef);
                    break;

                case iPaste:
                    DialogPaste(dialogRef);
                    break;

                case iClear:
                    DialogDelete(dialogRef);
                    break;
            }
        }
    }
}

// ***** doDemonstrationMenu

void doDemonstrationMenu(MenuBarItem menuItem)
{
    switch(menuItem)

```

```
{
    case iModalAlert:
        if(!doModalAlerts(false))
        {
            SysBeep(10);
            ExitToShell();
        }
        break;

    case iMovableAlert:
        if(gRunningOnX)
        {
            if(!doMovableModalAlertOnX())
            {
                SysBeep(10);
                ExitToShell();
            }
        }
        else if(!doModalAlerts(true))
        {
            SysBeep(10);
            ExitToShell();
        }
        break;

    case iModalDialog:
        if(!doModalDialog())
        {
            SysBeep(10);
            ExitToShell();
        }
        break;

    case iMovableModalDialog:
        if(!doMovableModalDialog())
        {
            SysBeep(10);
            ExitToShell();
        }
        break;

    case iModeless:
        if(!doCreateOrShowModelessDialog())
        {
            SysBeep(10);
            ExitToShell();
        }
        break;

    case iWindowModalAlert:
        if(!doSheetAlert())
        {
            SysBeep(10);
            ExitToShell();
        }
        break;
```

```

    case iWindowModalDialog:
        if(!doSheetDialog())
        {
            SysBeep(10);
            ExitToShell();
        }
        break;
    }
}

// ***** doExplicitlyDeactivateDocument

void doExplicitlyDeactivateDocument(void)
{
    if(FrontWindow() && (GetWindowKind(FrontWindow()) != kDialogWindowKind))
        doActivateDocument(FrontWindow(),false);
}

// ***** doModalAlerts

Boolean doModalAlerts(Boolean movable)
{
    AlertStdAlertParamRec paramRec;
    Str255                messageText, informativeText;
    Str255                otherText = "\pOther";
    OSErr                 osError;
    DialogItemIndex       itemHit;

    doExplicitlyDeactivateDocument();

    paramRec.movable      = movable;
    paramRec.helpButton   = true;
    paramRec.filterProc   = gEventFilterUPP;
    paramRec.defaultText  = (StringPtr) kAlertDefaultOKText;
    paramRec.cancelText   = (StringPtr) kAlertDefaultCancelText;
    paramRec.otherText    = (StringPtr) &otherText;
    paramRec.defaultButton = kAlertStdAlertOKButton;
    paramRec.cancelButton = kAlertStdAlertCancelButton;
    paramRec.position     = kWindowDefaultPosition;

    if(!movable)
        GetIndString(messageText,rAlertStrings,sModalMessage);
    else
        GetIndString(messageText,rAlertStrings,sMovableMessage);
    GetIndString(informativeText,rAlertStrings,sModalInformative);

    osError = StandardAlert(kAlertStopAlert,messageText,informativeText,&paramRec,&itemHit);
    if(osError == noErr)
    {
        if(itemHit == kAlertStdAlertOKButton)
            doCopyPString("\pOK Button hit",gCurrentString);
        else if (itemHit == kAlertStdAlertCancelButton)
            doCopyPString("\pCancel Button hit",gCurrentString);
    }
}

```

```

        else if (itemHit == kAlertStdAlertOtherButton)
            doCopyPString("\pOther Button hit",gCurrentString);
        else if (itemHit == kAlertStdAlertHelpButton)
            doCopyPString("\pHelp Button hit",gCurrentString);
    }

    return (osError == noErr);
}

// ***** doMovableModalAlertOnX

Boolean doMovableModalAlertOnX(void)
{
    AlertStdCFStringAlertParamRec paramRec;
    Str255                messageText, informativeText;
    CFStringRef           messageTextCF, informativeTextCF;
    OSErr                 osError;
    DialogRef             dialogRef;
    DialogItemIndex       itemHit;

    doExplicitlyDeactivateDocument();

    GetStandardAlertDefaultParams(&paramRec,kStdCFStringAlertVersionOne);
    paramRec.movable      = true;
    paramRec.helpButton   = true;
    paramRec.cancelButton = kAlertStdAlertCancelButton;
    paramRec.cancelText   = CFSTR("Cancel");
    paramRec.otherText    = CFSTR("Other");

    GetIndString(messageText,rAlertStrings,sMovableMessage);
    GetIndString(informativeText,rAlertStrings,sMovableInformative);
    messageTextCF = CFStringCreateWithPascalString(NULL,messageText,
                                                    CFStringGetSystemEncoding());
    informativeTextCF = CFStringCreateWithPascalString(NULL,informativeText,
                                                    CFStringGetSystemEncoding());

    osError = CreateStandardAlert(kAlertCautionAlert,messageTextCF,informativeTextCF,&paramRec,
                                &dialogRef);

    if(osError == noErr)
    {
        osError = RunStandardAlert(dialogRef,NULL,&itemHit);
        if(osError == noErr)
        {
            if(itemHit == kAlertStdAlertOKButton)
                doCopyPString("\pOK Button hit",gCurrentString);
            else if (itemHit == kAlertStdAlertCancelButton)
                doCopyPString("\pCancel Button hit",gCurrentString);
            else if (itemHit == kAlertStdAlertOtherButton)
                doCopyPString("\pOther Button hit",gCurrentString);
            else if (itemHit == kAlertStdAlertHelpButton)
                doCopyPString("\pHelp Button hit",gCurrentString);
        }
    }
}

```

```

    if(messageTextCF != NULL)
        CFRelease(messageTextCF);
    if(informativeTextCF != NULL)
        CFRelease(informativeTextCF);

    return (osError == noErr);
}

// ***** doModalDialog

Boolean doModalDialog(void)
{
    DialogRef  dialogRef;
    ControlRef controlRef;
    OSStatus  osError;
    MenuRef   menuRef;
    SInt16    numberOfItems, itemHit, controlValue;

    doExplicitlyDeactivateDocument();

    if(!(dialogRef = GetNewDialog(rModalDialog, NULL, (WindowRef) -1)))
        return false;

    SetDialogDefaultItem(dialogRef, kStdOkItemIndex);
    SetDialogCancelItem(dialogRef, kStdCancelItemIndex);

    GetDialogItemAsControl(dialogRef, iGridSnap, &controlRef);
    SetControlValue(controlRef, gGridSnap);
    GetDialogItemAsControl(dialogRef, iShowGrid, &controlRef);
    SetControlValue(controlRef, gShowGrid);
    GetDialogItemAsControl(dialogRef, iShowRulers, &controlRef);
    SetControlValue(controlRef, gShowRule);

    menuRef = NewMenu(mFont, NULL);

    if((osError = CreateStandardFontMenu(menuRef, 0, 0, 0, NULL)) == noErr)
    {
        GetDialogItemAsControl(dialogRef, iFont, &controlRef);
        SetControlMinimum(controlRef, 1);
        numberOfItems = CountMenuItems(menuRef);
        SetControlMaximum(controlRef, numberOfItems);
        SetControlData(controlRef, kControlEntireControl, kControlPopupButtonMenuRefTag,
            sizeof(menuRef), &menuRef);
    }
    else
        return false;

    if(gRunningOnX)
        helpTagsModal(dialogRef);

    ShowWindow(GetDialogWindow(dialogRef));

    do
    {
        ModalDialog(gEventFilterUPP, &itemHit);
    }

```

```

    if(itemHit == iGridSnap || itemHit == iShowGrid || itemHit == iShowRulers)
    {
        GetDialogItemAsControl(dialogRef,itemHit,&controlRef);
        SetControlValue(controlRef,!GetControlValue(controlRef));
    }
    else if(itemHit == iFont || itemHit == iSound)
    {
        GetDialogItemAsControl(dialogRef,itemHit,&controlRef);
        controlValue = GetControlValue(controlRef);
        doPopupMenuChoice(controlRef,controlValue);
    }
} while((itemHit != kStdOkItemIndex) && (itemHit != kStdCancelItemIndex));

if(itemHit == kStdOkItemIndex)
{
    GetDialogItemAsControl(dialogRef,iGridSnap,&controlRef);
    gGridSnap = GetControlValue(controlRef);
    GetDialogItemAsControl(dialogRef,iShowGrid,&controlRef);
    gShowGrid = GetControlValue(controlRef);
    GetDialogItemAsControl(dialogRef,iShowRulers,&controlRef);
    gShowRule = GetControlValue(controlRef);
}

DisposeDialog(dialogRef);

doCopyPString("\pBalloon (OS 8/9) and Help tag (OS X) help is available",gCurrentString);

return true;
}

// ***** doMovableModalDialog

Boolean doMovableModalDialog(void)
{
    DialogRef dialogRef;
    ControlRef controlRef;
    SInt16 oldBrushType, itemHit, a;

    doExplicitlyDeactivateDocument();

    if(!(dialogRef = GetNewDialog(rMovableModalDialog,NULL,(WindowRef) -1)))
        return false;

    SetDialogDefaultItem(dialogRef,kStdOkItemIndex);
    SetDialogCancelItem(dialogRef,kStdCancelItemIndex);
    SetDialogTracksCursor(dialogRef,true);

    GetDialogItemAsControl(dialogRef,gBrushType,&controlRef);
    SetControlValue(controlRef,kControlRadioButtonCheckedValue);

    GetDialogItemAsControl(dialogRef,iClockOne,&controlRef);
    SetKeyboardFocus(GetDialogWindow(dialogRef),controlRef,kControlClockPart);

    oldBrushType = gBrushType;

```

```

if(gRunningOnX)
    helpTagsMovableModal(dialogRef);

ShowWindow(GetDialogWindow(dialogRef));

do
{
    ModalDialog(gEventFilterUPP,&itemHit);

    if(itemHit >= iCharcoal && itemHit <= iChalk)
    {
        for(a=iCharcoal;a<=iChalk;a++)
        {
            GetDialogItemAsControl(dialogRef,a,&controlRef);
            SetControlValue(controlRef,kControlRadioButtonUncheckedValue);
        }

        GetDialogItemAsControl(dialogRef,itemHit,&controlRef);
        SetControlValue(controlRef,kControlRadioButtonCheckedValue);
        gBrushType = itemHit;
    }
} while((itemHit != kStdOkItemIndex) && (itemHit != kStdCancelItemIndex));

if(itemHit == kStdCancelItemIndex)
    gBrushType = oldBrushType;

DisposeDialog(dialogRef);

return true;
}

// ***** doCreateOrShowModelessDialog

Boolean doCreateOrShowModelessDialog(void)
{
    ControlRef controlRef;
    Str255      stringData = "\pwicked googly";
    MenuRef     menuRef;

    if(gModelessDialogRef == NULL)
    {
        if(!(gModelessDialogRef = GetNewDialog(rModelessDialog,NULL,(WindowRef) -1)))
            return false;

        SetWRefCon(GetDialogWindow(gModelessDialogRef),(SInt32) kSearchModeless);

        SetDialogDefaultItem(gModelessDialogRef,kStdOkItemIndex);

        GetDialogItemAsControl(gModelessDialogRef,iEditTextSearchModeless,&controlRef);
        SetDialogItemText((Handle) controlRef,stringData);
        SelectDialogItemText(gModelessDialogRef,iEditTextSearchModeless,0,32767);

        if(gRunningOnX)
            helpTagsModeless(gModelessDialogRef);
    }
}

```



```

        ShowWindow(GetDialogWindow(gModelessDialogRef));
    }
    else
    {
        ShowWindow(GetDialogWindow(gModelessDialogRef));
        SelectWindow(GetDialogWindow(gModelessDialogRef));
    }

    if(gRunningOnX)
    {
        menuRef = GetMenuRef(mFile);
        EnableMenuItem(menuRef,0);
    }

    return true;
}

// ***** doInContent

void doInContent(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    SInt32 windowRefCon;
    DialogRef dialogRef;
    SInt16 itemHit;

    windowRef = FrontWindow();

    if(!(IsDialogEvent(eventStrucPtr)))
    {
        // Handle clicks in document window content region here.
    }
    else
    {
        windowRefCon = GetWRefCon(windowRef);
        if(windowRefCon == kSearchModeless)
        {
            if(DialogSelect(eventStrucPtr,&dialogRef,&itemHit))
                if(itemHit == kStdOkItemIndex)
                    doButtonHitInSearchModeless();
        }
        else if(windowRefCon == kSheetDialog)
        {
            if(DialogSelect(eventStrucPtr,&dialogRef,&itemHit))
                if(itemHit == kStdOkItemIndex)
                    doButtonHitInSheetDialog();
        }
    }
}

// ***** doButtonHitInSearchModeless

void doButtonHitInSearchModeless(void)

```

```

{
    ControlRef controlRef;
    GrafPtr    oldPort;

    GetDialogItemAsControl(gModelessDialogRef,iEditTextSearchModeless,&controlRef);
    GetDialogItemText((Handle) controlRef,gCurrentString);

    GetPort(&oldPort);
    SetPortWindowPort(gWindowRef);
    doDrawMessage(gWindowRef,false);
    SetPort(oldPort);
}

// ***** doHideModelessDialog

void doHideModelessDialog(WindowRef windowRef)
{
    SInt16 windowRefCon;
    MenuRef menuRef;

    if(gRunningOnX)
        BringToFront(gWindowRef);

    HideWindow(windowRef);

    windowRefCon = GetWRefCon(windowRef);
    if(windowRefCon == kSearchModeless)
        gSleepTime = MAX_UINT32;

    if(gRunningOnX)
    {
        menuRef = GetMenuRef(mFile);
        DisableMenuItem(menuRef,0);
    }
}

// ***** eventFilter

Boolean eventFilter(DialogRef dialogRef,EventRecord *eventStrucPtr,SInt16 *itemHit)
{
    Boolean handledEvent;
    GrafPtr oldPort;

    handledEvent = false;

    if((eventStrucPtr->what == updateEvt) &&
        ((WindowRef) eventStrucPtr->message != GetDialogWindow(dialogRef)))
    {
        if(!gRunningOnX)
            doUpdate(eventStrucPtr);
    }
    else if((eventStrucPtr->what == autoKey) && ((eventStrucPtr->modifiers & cmdKey) != 0))
    {
        handledEvent = true;
        return handledEvent;
    }
}

```

```

    else
    {
        GetPort(&oldPort);
        SetPortDialogPort(dialogRef);

        handledEvent = StdFilterProc(dialogRef,eventStrucPtr,itemHit);

        SetPort(oldPort);
    }

    return handledEvent;
}

// ***** doPopupMenuChoice

void doPopupMenuChoice(ControlRef controlRef,SInt16 controlValue)
{
    MenuRef menuRef;
    Size    actualSize;
    Str255  itemName;
    GrafPtr oldPort;

    GetControlData(controlRef,kControlEntireControl,kControlPopupMenuHandleTag,
                    sizeof(menuRef),&menuRef,&actualSize);
    GetMenuItemText(menuRef,controlValue,itemName);
    doCopyPString(itemName,gCurrentString);

    GetPort(&oldPort);
    SetPortWindowPort(gWindowRef);
    doDrawMessage(gWindowRef,false);
    SetPort(oldPort);
}

// ***** doDrawMessage

void doDrawMessage(WindowRef windowRef,Boolean inState)
{
    Rect      portRect, headerRect;
    CFStringRef stringRef;
    Rect      textBoxRect;

    if(windowRef == gWindowRef)
    {
        SetPortWindowPort(windowRef);
        GetWindowPortBounds(windowRef,&portRect);
        SetRect(&headerRect,portRect.left - 1,portRect.bottom - 26,portRect.right + 1,
                portRect.bottom + 1);
        DrawThemePlacard(&headerRect,inState);

        if(inState == kThemeStateActive)
            TextMode(srcOr);
        else
            TextMode(grayishTextOr);
    }
}

```

```

    stringRef = CFStringCreateWithPascalString(NULL,gCurrentString,
                                              CFStringGetSystemEncoding());
    SetRect(&textBoxRect,portRect.left,portRect.bottom - 19,portRect.right,
          portRect.bottom - 4);
    DrawThemeTextBox(stringRef,kThemeSmallSystemFont,0,true,&textBoxRect,teJustCenter,NULL);
    if(stringRef != NULL)
        CFRelease(stringRef);

    TextMode(srcOr);
}
}

// ***** doCopyPString

void doCopyPString(Str255 sourceString,Str255 destinationString)
{
    SInt16 stringLength;

    stringLength = sourceString[0];
    BlockMove(sourceString + 1,destinationString + 1,stringLength);
    destinationString[0] = stringLength;
}

// *****
// Sheets.c
// *****

// ..... includes

#include "DialogsAndAlerts.h"

// ..... global variables

WindowRef gSheetDialogWindowRef = NULL;

extern WindowRef gWindowRef;
extern Boolean   gRunningOnX;
extern Str255    gCurrentString;

// ***** doSheetAlert

Boolean doSheetAlert(void)
{
    AlertStdCFStringAlertParamRec paramRec;
    Str255                        messageText, informativeText;
    CFStringRef                   messageTextCF, informativeTextCF;
    OSStatus                      osError;
    DialogRef                     dialogRef;
    MenuRef                      menuRef;

    GetStandardAlertDefaultParams(&paramRec,kStdCFStringAlertVersionOne);

    GetIndString(messageText,rSheetStrings,sAlertSheetMessage);
    GetIndString(informativeText,rSheetStrings,sAlertSheetInformative);

```

```

messageTextCF = CFStringCreateWithPascalString(NULL,messageText,
                                                CFStringGetSystemEncoding());
informativeTextCF = CFStringCreateWithPascalString(NULL,informativeText,
                                                    CFStringGetSystemEncoding());

osError = CreateStandardSheet(kAlertCautionAlert,messageTextCF,informativeTextCF,&paramRec,
                              GetWindowEventTarget(gWindowRef),&dialogRef);

if(osError == noErr)
    osError = ShowSheetWindow(GetDialogWindow(dialogRef),gWindowRef);

CFRelease(messageTextCF);
CFRelease(informativeTextCF);

menuRef = GetMenuRef(mDemonstration);
if(menuRef != NULL)
{
    DisableMenuItem(menuRef,iWindowModalDialog);
    DisableMenuItem(menuRef,iWindowModalAlert);
}

return (osError == noErr);
}

// ***** doSheetDialog

Boolean doSheetDialog(void)
{
    DialogRef dialogRef;
    ControlRef controlRef;
    Str255 stringData = "\pBradman";
    OSStatus osError = noErr;
    MenuRef menuRef;

    if(!(dialogRef = GetNewDialog(rSheetDialog,NULL,(WindowRef) -1)))
        return false;

    SetWRefCon(GetDialogWindow(dialogRef),(SInt32) kSheetDialog);

    SetDialogDefaultItem(dialogRef,kStdOkItemIndex);

    GetDialogItemAsControl(dialogRef,iEditTextSheetDialog,&controlRef);
    SetDialogItemText((Handle) controlRef,stringData);
    SelectDialogItemText(dialogRef,iEditTextSheetDialog,0,32767);

    gSheetDialogWindowRef = GetDialogWindow(dialogRef);
    osError = ShowSheetWindow(gSheetDialogWindowRef,gWindowRef);

    menuRef = GetMenuRef(mDemonstration);
    if(menuRef != NULL)
        DisableMenuItem(menuRef,iWindowModalDialog);

    return (osError == noErr);
}

```

```
// ***** doButtonHitInSheetDialog

void doButtonHitInSheetDialog(void)
{
    DialogRef dialogRef;
    ControlRef controlRef;
    GrafPtr oldPort;

    dialogRef = GetDialogFromWindow(gSheetDialogWindowRef);

    GetDialogItemAsControl(dialogRef,iEditTextSheetDialog,&controlRef);
    GetDialogItemText((Handle) controlRef,gCurrentString);

    HideSheetWindow(gSheetDialogWindowRef);
    DisposeDialog(dialogRef);
    gSheetDialogWindowRef = NULL;

    GetPort(&oldPort);
    SetPortWindowPort(gWindowRef);
    doDrawMessage(gWindowRef,true);
    SetPort(oldPort);
}

// *****
// HelpTags.c
// *****

// ..... includes

#include "DialogsAndAlerts.h"
#include <string.h>

// ***** helpTagsModal

void helpTagsModal(DialogRef dialogRef)
{
    HMHelpContentRec helpContent;
    SInt16 a;
    static SInt16 itemNumber[7] = { 1,2,3,7,8,10,11 };
    ControlRef controlRef;

    memset(&helpContent,0,sizeof(helpContent));

    HMSetTagDelay(500);
    HMSetHelpTagsDisplayed(true);

    helpContent.version = kMacHelpVersion;
    helpContent.tagSide = kHMOoutsideTopCenterAligned;
    helpContent.content[kHMMinimumContentIndex].contentType = kHMStringResContent;
    helpContent.content[kHMMinimumContentIndex].u.tagStringRes.hmmResID = 129;

    for(a = 1;a <= 7; a++)
```

```

    {
        helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = a;
        GetDialogItemAsControl(dialogRef,itemNumber[a - 1],&controlRef);
        HMSSetControlHelpContent(controlRef,&helpContent);
    }
}

// ***** helpTagsMovableModal

void helpTagsMovableModal(DialogRef dialogRef)
{
    HMHelpContentRec helpContent;
    SInt16          a;
    static SInt16    itemNumber[9] = { 1,2,3,4,6,11,12,13,14 };
    ControlRef       controlRef;

    memset(&helpContent,0,sizeof(helpContent));

    HMSSetTagDelay(500);
    HMSSetHelpTagsDisplayed(true);

    helpContent.version = kMacHelpVersion;
    helpContent.tagSide = kHMOOutsideTopCenterAligned;
    helpContent.content[kHMMMinimumContentIndex].contentType = kHMStringResContent;
    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmResID = 130;

    for(a = 1;a <= 9; a++)
    {
        helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = a;
        GetDialogItemAsControl(dialogRef,itemNumber[a - 1],&controlRef);
        HMSSetControlHelpContent(controlRef,&helpContent);
    }
}

// ***** helpTagsModeless

void helpTagsModeless(DialogRef dialogRef)
{
    HMHelpContentRec helpContent;
    SInt16          a;
    static SInt16    itemNumber[7] = { 1,2,3,4,5,6,7 };
    ControlRef       controlRef;

    memset(&helpContent,0,sizeof(helpContent));

    HMSSetTagDelay(500);
    HMSSetHelpTagsDisplayed(true);

    helpContent.version = kMacHelpVersion;
    helpContent.tagSide = kHMOOutsideTopCenterAligned;
    helpContent.content[kHMMMinimumContentIndex].contentType = kHMStringResContent;
    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmResID = 131;

    for(a = 1;a <= 7; a++)

```



```

{
    helpContent.content[kHMMinimumContentIndex].u.tagStringRes.hmmIndex = a;
    GetDialogItemAsControl(dialogRef,itemNumber[a - 1],&controlRef);
    HMSetControlHelpContent(controlRef,&helpContent);
}
}

// *****

```

## Demonstration Program DialogsAndAlerts Comments

When this program is run, the user should

- Invoke alerts and dialogs by choosing items in the Demonstration menu, noting window update/activation/deactivation and menu enabling/disabling effects.
- On Mac OS 8/9, choose Show Balloons from the Help menu and pass the cursor over the various items in the dialogs, noting the information in the help balloons. Also note the updating of alerts and dialogs, and of the window, behind the help balloon when the balloon closes.
- On Mac OS X, pause the cursor over the various items in the dialogs, noting the information in the help tags.
- Note the effects on the menus when the various alerts and dialogs are the front window.
- Click anywhere outside the modal alert and modal dialog when they are the frontmost window, noting that the only response is the system alert sound.
- Note that, when the movable modal alert and movable modal dialog are displayed
  - The program can be sent to the background by clicking outside the alert or dialog and the document window, or by bringing another application to the foreground.
  - The program can be brought to the foreground again by clicking inside the alert or dialog, or the document window.
- Note that, when the movable modal dialog and (on Mac OS X) the window-modal (sheet) dialog are displayed, the Edit menu and its Cut, Copy, and Paste items are enabled, given that the edit text items in these dialogs always have keyboard focus.
- Note that, when the modeless dialog is displayed
  - It behaves like a normal document window when the user:
    - Clicks outside it when it is the frontmost window.
    - Clicks inside it when it is not the frontmost window.
  - It can be hidden by clicking in the close box/button or by selecting Close from the File menu.

- A modal alert, movable modal alert, modal dialog or movable modal dialog can be invoked “on top of” the modeless dialog.
- The Edit menu and its Cut, Copy, Paste, and Clear items are enabled so as to support text editing in the edit text item.
- Note that all alerts and dialogs respond correctly to Return and Enter key presses, and that the modal alert, modal dialog and movable modal dialog also respond correctly to escape key and Command-period presses.
- Note that, when an alert or dialog is the frontmost window, the window and content region are deactivated, the latter evidenced by dimming of the text in the document window’s window header.
- In the modal dialog, click on the checkboxes to change their settings, noting that the new settings are remembered when the dialog is dismissed using the OK button, but not remembered when the dialog is dismissed using the Cancel button. Also, choose items in the two pop-up menus, noting that the chosen item is displayed in the document window’s window header.
- In the movable modal dialog, click on the radio buttons to change their settings, noting that the new setting is remembered when the dialog is dismissed using the OK button, but not remembered when the dialog is dismissed using the Cancel button. In the case of the clock control and edit text item, change the item/part with keyboard focus using the Tab key or by clicking in that item/part. In the case of the edit text item, enter text, and edit that text using the Edit menu’s Cut, Copy, Paste, and Clear items and their Command-key equivalents. Note that the cursor shape changes whenever the cursor is moved over the edit text item.
- In the modeless dialog and (on Mac OS X) the window-modal (sheet) dialog, enter text, and edit that text using the Edit menu’s Cut, Copy, Paste, and Clear items and their Command-key equivalents. Note that, because no cursor adjustment function is included in the program, the cursor shape does not change whenever the cursor is moved over the edit text item. Also note that, when the Search button is clicked (or the Return or Enter keys are pressed) the text in the edit text item is displayed in the document window’s window header.
- On Mac OS X, when a window-modal (sheet) alert or dialog is showing, minimize the window into the Dock and then expand the window from the dock.

In the 'DITL' resources for the modal and movable modal dialogs, note that the item numbers of the primary group box items are lower than the item numbers of the items visually contained by those group box items. This is to ensure that the group boxes do not draw over, and thus erase, the image of these contained items.

In the 'dlgx' resources, note that all feature flags are set except for the `kDialogFlagsHandlesMovableModal` flag in 'dlgx' resources for the modal dialog and modeless dialog. Thus dialogs have a root control and embedding hierarchy.

Although, for demonstration purposes, this program creates modal alerts and dialogs, it is emphasized that Aqua Human Interface Guidelines require that, on Mac OS X, applications use modal alerts and dialogs only in exceptional purposes. On Mac OS X, the vast majority of alerts and dialogs should be application-modal or window-modal.

On Mac OS X, explanatory Help tags are available for the modal, movable modal, and modeless dialogs. The associated source code (in the source code file `HelpTags.c`) is not explained in these comments because the provision of Help tags is incidental to the demonstration. For information on creating help tags, see Chapter 25. Note that it is also possible to display help tags on Mac OS 8/9; however, it is considered by the author that their “look” is somewhat at odds with the Platinum appearance, and that help balloons remain the most appropriate option for Mac OS 8/9.

The CodeWarrior project for this program adds the `CarbonFrameWorksLib` stub library because certain functions are used that are only available on Mac OS X. (See “Carbon and Available APIs” in Chapter 25.) Those functions (`CreateStandardAlert`, `RunStandardAlert`, `GetStandardAlertDefaultParams`, `CreateStandardSheet`, `ShowSheetWindow`, `HideSheetWindow`) are only called when the program is run on Mac OS X.

## DialogsAndAlerts.h

### Defines

Constants are established for dialog resource IDs and for the item numbers of certain items in the item lists associated with the dialogs. `rAlertStrings` and `rSheetStrings` represent the resource IDs of 'STR#' resources holding strings for the message and informative text (label and narrative text in Mac OS 8/9 parlance) for the modal alert, movable modal alert, and window-modal (sheet) alert.

The values represented by `kSearchModeless` and `kSheetDialog` will be stored as the reference constant in the window object in, respectively, the modeless dialog and window-modal (sheet) dialog objects. This enables the program to distinguish between these two dialogs.

The penultimate block establishes constants representing the character codes for the Return, Enter, escape, and period keys.

Finally, `MAX_UINT32` is defined as the maximum possible unsigned long value. This value will be assigned to `WaitNextEvent`'s sleep parameter at program launch.

## DialogsAndAlerts.c

### Global Variables

`gEventFilterUPP` will be assigned a universal procedure pointer to an application-defined event filter (callback) function. `gSleepTime` will be assigned the value to be used as the sleep parameter in the `WaitNextEvent` call. (This value will be changed during program execution.)

The three variables after `gDone` will store the current control value of the checkboxes in the modal dialog. The next variable will store the item number of the currently selected radio button in the movable modal dialog.

Finally, the pointer to the dialog object for the modeless dialog is declared as a global variable.

### main

`GetNewDialog` is called to create a small modal dialog. `SetDialogTimeout` is then called with 10 (seconds) passed in the `inSecondsToWait` parameter and 1 passed in the `inButtonToPress` parameter. (In the associated 'DITL' resource, Item 1 is the OK push button, which has been hidden.) The use of `SetDialogTimeout` requires that the application handle events for the dialog through the `ModalDialog` function, hence the `ModalDialog` do-while loop. This allows the Dialog Manager to simulate an item selection. After 10 seconds, the Dialog Manager simulates a user click in the (invisible) OK button, causing the do-while loop to exit. The dialog is then disposed of. (Note that pressing the Return key before the 10 seconds has elapsed will also dispose of the dialog.)

The call to `NewModalFilterUPP` creates a universal procedure pointer for the event filter (callback) function.

Note that error handling here and in other areas of this demonstration program is somewhat rudimentary. In the unlikely event that certain calls fail, `ExitToShell` is called to terminate the program.

### eventLoop

The variable that will be used as `WaitNextEvent`'s sleep parameter (`gSleepTime`) is initially set to the maximum unsigned long value. Note that the value assigned to `gSleepTime` will be changed at certain points in the program.

When a NULL event is returned by `WaitNextEvent`, if the program is running on Mac OS 8/9, `doIdle` is called.

### doIdle

`doIdle` is invoked, on Mac OS 8/9 only, whenever `WaitNextEvent` returns a null event.

If the front window is the modeless dialog, the function `IdleControls` is called. `IdleControls` calls the control definition function of those controls in the specified window which do idle-time processing. In this case, the control is an edit text control, and the call causes the control definition function to call `TextEdit` to blink the insertion point caret. (This call is not necessary on Mac OS X because controls on Mac OS X have built-in timers.)

### **doEvents**

`doEvents` switches according to the event type received. (It is important to remember at this point that events that occur when the modal dialog or movable modal dialog have been invoked are not handled by the main event loop but by the `ModalDialog` function.)

Note that, at the `autoKey` case, the function `doKeyDown` is called only if the Command key is not down. This is to prevent the Command-key equivalents for cut, copy, and paste from repeating when the user presses and holds down those Command-key equivalents while editing text in the modeless dialog's edit text item.

In this program, `autoKey` events generated while the Command key is down are also discarded in the event filter (callback) function `eventFilter` (see below). This means that the behavior of the edit text item in the movable modal dialog will replicate that of the edit text item in the modeless dialog.

(Many commercial and shareware programs (BBEdit excepted) do not discard `autoKey` events in these circumstances. The author considers that to be an oversight.)

### **doMouseDown**

`doMouseDown` handles mouse-down events. Mouse-downs in the content region and in the close box/button are of significance to the demonstration. If a mouse-down occurred in a close box/button, if `TrackGoAway` returns true, and if the window is the modeless dialog, `doHideModelessDialog` is called. (In this demonstration, the modeless dialog, but not the document window, has a close box/button.)

### **doKeyDown**

`doKeyDown` handles all key-down and auto-key events.

First, the character code is extracted from the message field of the event structure. Then `IsDialogEvent` is called to determine whether the event occurred in the modeless dialog or window-modal (sheet) dialog, or in the document window.

If the event occurred in a document window, and if the modifiers field of the event structure indicates that the Command key was down, the function for adjusting the menus is called, `MenuEvent` is called to return the long value containing the menu and menu item associated with the Command-key equivalent, and the long value is passed to `doMenuChoice` for further handling.

If, however, the event occurred in the modeless dialog or window-modal (sheet) dialog

- If the key pressed was the Return or Enter key, `GetDialogItemAsControl` is called to get a reference to the single push button control in the modeless dialog (item 1 in the item list). The push button is then highlighted for eight ticks (this has an effect on Mac OS 8/9 only), and then unhighlighted before a function is called to extract the text from the edit text item and display it in the document window's window header. `doKeyDown` then returns because it is not intended that the edit text item receive Return and Enter key presses.
- If the Command key was down
  - If either the X, C, or V key was pressed (that is, the user has pressed the Cut, Copy, or Paste Command-key equivalent), `DialogSelect` is called to further handle the event. `DialogSelect` uses `TextEdit` to cut, copy, or paste the text in the edit text item. (The calls to `HiLiteMenu` briefly highlight the Edit menu to indicate to the user that an Edit menu Command-key equivalent has just been used. This replicates the highlighting that `ModalDialog` performs when Command-key presses occur in modal and movable modal dialogs with edit text items.)
  - If neither the X, C, nor V key was pressed, the function for adjusting the menus is called, `MenuEvent` is called to return the long value containing the menu and menu item associated with the Command-key equivalent, and the long value is passed to `doMenuChoice` for further handling.
  - `doKeyDown` returns so as to bypass the second call to `DialogSelect`.

Thus the Command-key equivalents other than those for Cut, Copy, and Paste remain available to the user via the main event loop, while the Command-key equivalents for Cut, Copy, and Paste are trapped and passed to `DialogSelect` for handling.

- If the Return key and the Enter key were not pressed, and if the Command key was not down, `DialogSelect` is called to handle the keystroke in conjunction with `TextEdit`, the visual result being that the character appears in the edit text item.

## doUpdate

`doUpdate` performs the initial handling of update events.

If the call to `IsDialogEvent` reveals that the event is for a window of the document kind, a function for updating the document window is called.

If the event is for the modeless dialog or window-modal (sheet) dialog, `DialogSelect` is called to handle the event. `DialogSelect` calls `BeginUpdate`, `DrawDialog`, and `EndUpdate` to redraw the dialog's content area. To restrict the redraw to the update region, an alternative is to call `BeginUpdate`, `UpdateDialog`, and `EndUpdate`. (Recall here that update regions `BeginUpdate` and `EndUpdate` are irrelevant on Mac OS X.)

Note that, on Mac OS X, the call to `DialogSelect` is really only necessary in the case of the window-modal (sheet) dialog.

### **doUpdateDocument**

`doUpdateDocument` simply fills the content region of the document window with a color, using a pixel patter ('ppat') resource and a call to `FillCRect` for that purpose, and then calls a function which draws a window header frame and the current contents of `gCurrentString`.

### **doActivate**

`doActivate` performs initial handling of activate events. If the call to `IsDialogEvent` reveals that the event is for a window of the document kind, the function for activating/deactivating the document window is called, otherwise the function for activating/deactivating the modeless dialog is called.

### **doActivateDocument**

`doActivateDocument` performs window activation/deactivation for the document window. If the window is becoming active, the menus are adjusted as appropriate for a document window. The call `doDrawMessage` draws a window header frame in the window, and the current contents of `gMessageString`, in either the activated or deactivated mode.

### **doActivateDialogs**

`doActivateDialogs` performs window activation and deactivation for the modeless dialog and window-modal (sheet) dialog.

`DialogSelect` is called to handle the event. If the modeless or window-modal (sheet) dialog is becoming active, `DialogSelect` activates all controls and, on Mac OS 8/9, redraws the one-pixel-wide modeless dialog frame in the active mode. If the modeless dialog is going to the back, `DialogSelect` deactivates all controls and, on Mac OS 8/9, redraws the one-pixel-wide modeless dialog frame in the inactive mode.

In the remaining code, if either the modeless dialog or window-modal (sheet) dialog is becoming active, the menus are adjusted and the global variable used in the sleep parameter of the `WaitNextEvent` function is assigned the value returned by `GetCaretTime` (the cursor-blinking interval set by the user in the General Controls control panel (Mac OS 8/9) and System preferences (Mac OS X)). This is necessary to ensure that null events will always be generated, and thus `doIdle` and `IdleControls` will be called (necessary on Mac OS 8/9 only), at an interval short enough to ensure insertion point caret blinking at the proper rate.

If either the modeless dialog or window-modal (sheet) dialog is being deactivated, the sleep parameter for the `WaitNextEvent` function is reset to the maximum unsigned long value.

(Recall that changing the value in `gSleepTime` is irrelevant on Mac OS X because the function `doIdle` will not be called when the program is running on Mac OS X.)



### **doAdjustMenus**

Note that, if the program is running on Mac OS X, and a call to `IsWindowCollapsed` reveals that the document window has been minimized to the dock, the menu items which invoke the window-modal (sheet) alert and (sheet) dialog are disabled.

### **doMenuChoice**

`doMenuChoice` handles menu choices. If the choice was the Close item in the File menu, and if the front window is the modeless dialog, a function that hides that modeless dialog is called. (In this program, because the document window does not have a close box/button, the Close item is only enabled when the modeless dialog is the front window.)

### **doEditMenu**

`doEditMenu` first determines whether the front window is the modeless dialog or window-modal (sheet) dialog (both of which have an edit text item). If so, a reference to the dialog is obtained, following which Dialog Manager functions are called to cut, copy, paste, or clear text as appropriate. The Dialog Manager, in conjunction with `TextEdit`, performs these operations.

### **doDemonstrationMenu**

`doDemonstrationMenu` handles choices from the Demonstration menu, switching according to the menu item passed to it. Error handling in this function is somewhat rudimentary in that the program simply terminates.

Note that, when the Modal Alert item is chosen, `doModalAlerts` is called with `false` is passed in the function's parameter. Note also that, when the Movable Modal Alert item is chosen, `doMovableModalAlertonX` is called if the program is running on Mac OS X, otherwise `doModalAlerts` is called with `true` passed in the function's parameter. This latter reflects the fact that, on Mac OS X, the movable modal alert will be created by a function that is not available on Mac OS 8/9.

### **doExplicitlyDeactivateDocument**

`doExplicitlyDeactivateDocument` is called at the beginning of those functions that create modal and movable modal alerts and dialogs.

If there is at least one window of any type open, and if that front window is of the document kind, the function for activating/deactivating document windows is called to deactivate the window.

### **doModalAlerts**

`doModalAlerts` creates, displays, manages, and disposes of the modal alert and, on Mac OS 8/9, the movable modal alert.

The call to `doExplicitlyDeactivateDocument` deactivates the document window.

At the next nine lines, values are assigned to the fields of a standard alert parameter structure. In sequence: the alert is to be modal or movable modal depending on the value received in the formal parameter `movable`; a help button is to be displayed; the event filter (callback) function used is to be the application-defined event filter (callback) function pointed to by the universal procedure pointer `gEventFilterUPP`; the default title for the OK push button is to be used; a Cancel push button is required, and is to have the default title for the Cancel button; an Other push button is required, and is to have the title “Other”; the default push button is to be the first push button (which will thus have the default ring drawn around it (Mac OS 8/9) or be pulsing blue (Mac OS X) and have the Return and Enter keys aliased to it); the Cancel push button is to be the second push button (which will thus have escape and Command-period key presses aliased to it); the alert is to be displayed in the alert position on the parent window screen. (With regard to the last field, the constant `kWindowDefaultPosition` equates to `kWindowAlertPositionParentWindowScreen`.)

The calls to `GetIndString` retrieve the specified strings from the specified 'STR#' resource. These are passed in the `inError` and `inExplanation` parameters in the following call to `StandardAlert`.

The call to `StandardAlert` creates and displays the alert (specifying a Stop alert in the first parameter), and handles all user interaction (by internally calling `ModalDialog`), including dismissing the alert when either the OK, Cancel, or Other button is hit. The item hit is returned in `StandardAlert`'s `outItemHit` parameter.

In a real application, the appropriate action would be taken, based on which push button was hit, following the call to `StandardAlert`; however, in this demonstration, the identity of the push button is simply drawn in the document window.

### **doMovableModalAlertOnX**

`doMovableModalAlertOnX` creates, displays, manages, and disposes of the movable modal alert when the program is run on Mac OS X. (The functions used in `doMovableModalAlertOnX` to create, display, and manage the alert are not available on Mac OS 8/9.)

The call to `doExplicitlyDeactivateDocument` deactivates the document window.

The call to `GetStandardAlertDefaultParams` initialises a standard `CFString` alert parameter structure with default values. (The defaults are: not movable; no Help button; no Cancel button; no Other button; alert position on parent window screen.) The next four lines modify the defaults by specifying that the alert is to be movable modal, and is to have a Help, Cancel, and Other, push button.

The two calls to `GetIndString` retrieve the specified strings from the specified 'STR#' resource, which are then converted to `CFStrings` before being passed in the error and explanation fields in the following call to `CreateStandardAlert`. `CreateStandardAlert` creates the alert.

The call to `RunStandardAlert` displays the alert and runs the alert using a `ModalDialog` loop. When a push button is clicked, its item number is returned in the `outItemHit` parameter

In a real application, the appropriate action would be taken, based on which push button was hit, following the call to `RunStandardAlert`; however, in this demonstration, the identity of the push button is simply drawn in the document window.

### **doModalDialog**

`doModalDialog` creates, displays, manages, and disposes of the modal dialog.

The call to `doExplicitlyDeactivateDocument` deactivates the document window.

The call to `GetNewDialog` creates the modal dialog from the specified resource as the frontmost window.

The call to `SetDialogDefaultItem` tells the Dialog Manager which is the default push button item and aliases the Return and Enter keys to that item. The call to `SetDialogCancelItem` tells the Dialog Manager which is the Cancel push button item, and aliases the escape key and Command-period key presses to that item.

The next block gets handles to the three checkbox controls and sets the value of those controls to the current values contained in the global variables relating to each control.

The call to `NewMenu` creates a new empty menu for a font menu. A reference to this menu is passed in the call to `CreateStandardFontMenu`, which creates a non-hierarchical font menu containing the names of all resident fonts. `GetDialogItemAsControl` gets a reference to the Font pop-up menu button control, facilitating the calls to `SetControlMinimum`, `SetControlMaximum`, and `SetControlData`. The latter sets the menu to be used by the pop-up menu button control.

With the modal dialog fully prepared, it is made visible by the call to `ShowWindow`.

The `do/while` loop continues to execute until `ModalDialog` reports that either the OK or Cancel button has been “hit.” Within the loop, `ModalDialog` retains control until one of the enabled items has been hit.

If a checkbox is hit, `GetDialogItemAsControl` is called to get a reference to the control and `SetControlValue` is called to flip that control’s control value. (If it is 0, it is flipped to 1, and vice versa.) If one of the pop-up menu buttons is hit, `GetDialogItemAsControl` is called to get a reference to the control and `GetControlValue` is called to get the menu item number of the menu item chosen, following which an function is called to extract the menu item text and display it in the window header.

Note that the first parameter in the `ModalDialog` call is a universal procedure pointer to the application-defined event filter (callback) function.

When the `do/while` loop exits, and if the user hit the OK button, handles to each of the three checkboxes are retrieved for the purposes of retrieving the control's value and assigning it to the relevant global variable. (If the user hit the Cancel button, the global variables retain the values they contained before the dialog was created and displayed.)

The dialog is then disposed of.

### **doMovableModalDialog**

`doMovableModalDialog` creates, displays, manages, and disposes of the movable modal dialog.

The call to `doExplicitlyDeactivateDocument` deactivates the document window.

The call to `GetNewDialog` creates the movable modal dialog from the specified resource as the frontmost window.

The call to `SetDialogDefaultItem` tells the Dialog Manager which is the default push button item and aliases the Return and Enter keys to that item. The call to `SetDialogCancelItem` tells the Dialog Manager which is the Cancel push button item and aliases the escape key and Command-period key presses to that item. The call to `SetDialogTracksCursor` tells the Dialog Manager to track the cursor and change it to the I-Beam cursor shape whenever it is over an edit text item.

The first call to `GetDialogItemAsControl` gets a reference to the radio button control represented by the current value in the global variable `gBrushType`. The value of that control is then set to 1. The second call to `GetDialogItemAsControl` gets a reference to the clock control. The call to `SetKeyboardFocus` sets the keyboard focus to that item.

Before the session of user interaction begins, the current value in the global variable `gBrushType`, which stores the item number of the currently selected radio button, is copied to the local variable `oldBrushType`. (This may be required later.)

With the movable modal dialog fully prepared, it is made visible by the call to `ShowWindow`.

The `do/while` loop continues to execute until `ModalDialog` reports that either the OK or Cancel button has been hit. Within the loop, `ModalDialog` retains control until one of the enabled items is hit.

If a radio button is hit, a `for` loop sets the control value of all radio button controls to 0. A call to `GetDialogItemAsControl` then gets a reference to the radio button control that was hit. A call to `SetControlValue` then sets that control's value to 1, and the item number of this radio button is assigned to the global variable `gBrushType`.

Note that the first parameter in the `ModalDialog` call is a universal procedure pointer to the application-defined event filter (callback) function. Note also that all user interaction relating to the clock control and edit text item is handled automatically by `ModalDialog`, including the movement of keyboard focus between the items.

When the `do/while` loop exits, and if the user hit the Cancel button, the value stored in the local variable `oldBrushType` is assigned to `gBrushType`, ensuring that any change to the currently selected radio button within the `do/while` loop is ignored. (In a real application, a long date/time value from the clock control, and the text from the edit text item would possibly be retrieved at this point if the user hit the OK push button.)

### **doCreateOrShowModelessDialog**

In this program, the modeless dialog is only created once, that is, when the user first chooses Modeless Dialog from the Demonstration menu. Clicks in its close box/button, or choosing Close from the File menu while the modeless dialog is the frontmost window, will cause the dialog to be hidden, not disposed of.

Accordingly, the first line determines whether the modeless dialog is already open. If it is not: the call to `GetNewDialog` creates the modeless dialog; the call to `SetWRefCon` assigns the reference constant `kSearchModeless` to the dialog object's window object so as to differentiate this dialog from the window-modal (sheet) dialog; a call to `SetDialogDefaultItem` causes the push button to be drawn with the default ring (Mac OS 8/9) or in pulsing blue (Mac OS X); a call to `SetDialogItemText` assigns some initial text to the edit text item; a call to `SelectDialogItemText` selects the text in the edit text item. (Note that if the edit text item did not contain text this latter call would simply display the insertion point caret, which would be made to blink by the call to `IdleControls` within the function `doIdle` (Mac OS 8/9).)

If, on the other hand, the modeless dialog has already been opened, the call to `ShowWindow` displays the dialog and the call to `SelectWindow` generates the necessary activate events.

### **doInContent**

`doInContent` continues the content region mouse-down handling initiated by `doMouseDown`. `doInContent` is called by `doMouseDown` only if the mouse-down occurred in the frontmost (active) window.

If the event occurred in the document window, the mouse-down event would be handled in the `if` section of the `if/else` block. (No action is required in this demonstration.)

If the event occurred in the modeless dialog or the window-modal (sheet) dialog (both of which contain an edit text item), `DialogSelect` is called to handle the event. `DialogSelect` tracks enabled controls (only the push button is enabled), returning true if the mouse button is released while the cursor is still inside the control, and highlights any selection made in the edit text item. If `DialogSelect` returns true, and if the item hit was the OK push button, a function is called to perform the actions required in the event of a hit on that button.

### **doButtonHitInSearchModeless**

`doButtonHitInSearchModeless` further processes, to completion, a hit on the OK (Search) button in the modeless dialog. It simply demonstrates retrieval of the text in an edit text item in a dialog.

The call to `GetDialogItemAsControl` gets a reference to the edit text control, and the call to `GetDialogItemText` copies the text in the edit text control to the global variable `gCurrentString`. The following lines cause that text to be drawn in the window header in the document window.

### **doHideModelessDialog**

`doHideModelessDialog` hides a modeless dialog. The call to `HideWindow` makes the dialog invisible. The sleep parameter for the `WaitNextEvent` function is reset to the maximum possible long value (relevant only on Mac OS 8/9), because insertion point caret blinking is not required while the Search dialog is hidden.

### **eventFilter**

`eventFilter` is the application-defined event filter (callback) function which, in conjunction with `ModalDialog`, handles events in the modal alerts, movable modal alert on OS 8/9, modal dialog and movable modal dialog.

If the program is running on Mac OS 8/9, if the event is an update event, and if that event is not for the dialog or alert in question, the application's document window updating function is called and false is returned. This response to an update event in the application's own document windows also allows `ModalDialog` to perform a minor switch when necessary so that background applications can update their windows as well. The call to the window updating function is not necessary on Mac OS X.

If the event is an `autoKey` event and the Command key is down, the event is, in effect, discarded. This means that, if the user is working within the edit text item in the movable modal dialog and presses and holds the Command key equivalents for Cut, Copy or Paste, repeating cut, copy and paste actions will be defeated. That is, pressing and holding the Command key equivalent will only result in a single cut, copy, or paste action. (See also `doEvents`, above.)

If the event is neither an update event nor an `autoKey` event with the Command key down, the current graphics port is saved and then set to that of the alert or dialog. The event is then passed to the standard event filter (callback) function for handling. If the standard event filter (callback) function handles the event, it will return true and, in the `itemHit` parameter, the number of the item that it handled. `ModalDialog` will then return this item number. A call to `SetPort` then restores the previously save graphics port.

Note that the calls to `GetPort` and `SetPort` are actually redundant when this event filter (callback) function is used by all but the movable modal dialog. The calls are only necessary when `SetDialogTracksCursor` has been called to cause the Dialog Manager to automatically track the cursor, and the movable modal dialog is the only dialog which requires this tracking (because it contains an edit text item.)

**doPopupMenuChoice, doPlaySound, doDrawMessage, and doCopyPString**

doPopupMenuChoice, doPlaySound, doDrawMessage, and doCopyPString are incidental to the demonstration. All perform the same duties as the similarly-named functions in the demonstration program Controls1 (Chapter 7). doDrawMessage is used in this program to prove the explicit deactivation of the document window's content area when alerts and dialogs other than the modeless dialog are invoked.

**Sheets.c****Global Variables**

gSheetDialogWindowRe will be assigned the window reference of the window-modal (sheet) dialog.

**doSheetAlert**

doSheetAlert creates, displays, and handles a window-modal (sheet) alert.

The call to GetStandardAlertDefaultParams initializes a standard CFString alert parameter structure with default values.

The two calls to GetIndString retrieve the specified strings from the specified 'STR#' resource, which are then converted to CFStrings before being passed in the error and explanation fields in the following call to CreateStandardSheet, which creates the alert. The call to ShowSheetWindow displays the sheet. When the user clicks the OK button, the sheet is dismissed.

**doSheetDialog**

doSheetAlert creates and displays a window-modal (sheet) dialog.

The call to GetNewDialog creates the dialog from the specified resource. The call to SetWRefCon assigns a value as the dialog window's reference constant. This is used elsewhere to differentiate the window-modal (sheet) dialog from the modeless dialog.

The call to SetDialogDefaultItem causes the push button to be drawn with the default ring (Mac OS 8/9) or in pulsing blue (Mac OS X). The call to SetDialogItemText assigns some initial text to the edit text item and the call to SelectDialogItemText selects that text.

The next line assigns a reference to the dialog's window to the global variable gSheetDialogWindowRef. This is used in the function doButtonHitInSheetDialog.

The call to ShowSheetWindow displays the sheet.

**doButtonHitInSheetDialog**

doButtonHitInSearchModeless is called from doKeyDown and doInContent to further process, to completion, a hit on the OK button in the window-modal (sheet) dialog. In addition to retrieving the text in an edit text item, it hides and disposes of the dialog.



# The Finder and the Application

## CHAPTER

# 9

## IN THIS CHAPTER

- Introduction 428
- An Application's Required Resources 429
- Application Signature, File Creator, and File Types 430
- Icons for the Finder 432
- File Reference ('FREF') Resources 436
- The Bundle ('BNDL') Resource 437
- The Version ('vers') Resource 440
- Finder Icon Help ('hfdi') Resource—Mac OS 8/9 442
- Missing Application and Application-Missing Resources—Mac OS 8/9 442
- The 'plst' Resource and Information Property Lists 445
- Application Launching by the Finder 448
- The Finder and the Catalog File 448
- Preferences, Temporary Items, and Trash Folders—Using FindFolder 450
- Stationery Pads 450
- Using Aliases 451
- Mac OS 9 Packages and Mac OS X Bundles 451
- Relevant Constants, Data Types, and Functions 453
- Demonstration Programs 454

## Introduction

### The Finder

The **Finder** is an application that works with the system software to mediate the user's access to volumes, folders and files in the file system, present a visual representation of those volumes, folders, and files to the user on the desktop, and generally manage the desktop. The term desktop in this context simply means the work area on the screen.

The Finder requires that your application supply it with certain information. The Finder accesses this information and builds its own database of the resources it needs, such as the icons to use to display your application and the documents it creates.

The Finder uses certain high-level events known as **Apple events** to communicate certain instructions and information to your application. Accordingly, this chapter should be read in conjunction with Chapter 10.

### Relevant Databases

#### The Desktop Database—Mac OS 8/9

When a file is created or installed, the File Manager extracts some of the information provided by resources described in this chapter and stores it in the volume's **catalog file**, a special file containing information about the hierarchical organization of files and folders on that volume.

Although it is mostly used by the File Manager, the information in the catalog file is also used by the Mac OS 8/9 Finder. The Finder extracts the information provided by your application and uses it to build a **desktop database**. The purpose of the desktop database is to facilitate rapid access by the Finder to icons, file types, applications, version data, and comments. The Finder builds the desktop databases for each mounted volume at system start-up, and updates them as files and directories are added, moved, renamed or deleted.

The desktop database:

- Contains the definitions of all icons and their associated file types.
- Lists all the file types that an application can open.
- Lists the location of each application on the disk.
- Contains any comments that the user has added to the information windows (the window opened when the user selects an icon and chooses Get Info from the Mac OS 8/9 Finder's File menu) for desktop objects.

## The Finder's Private Databases—Mac OS X

Mac OS X maintains a number of private databases, one of which is the **application database**. Because of the multi-user nature of Mac OS X, the Finder maintains an application database for each user with an account on the system. This database contains information about all the applications the Mac OS X Finder has encountered for that user and includes information about the document types understood by each application.

If your application includes a 'plist' (property list) resource, which itself includes a binary representation of an **information property list** containing the necessary information, the Mac OS X Finder extracts the information it requires from that list. If the 'plist' resource is empty, the Mac OS X Finder extracts the information provided by the signature, file reference, bundle, and version resources described in this chapter.

### NOTE

As will be seen, an application's 'plist' resource must contain an information property list in order for it to specify large (128-by-128 pixel) thumbnail icons for itself and its documents. Since this will ordinarily be the requirement, the following assumes that the application includes an information property list containing all relevant information in its 'plist' resource.

Note also that, in so-called "bundled" Mac OS X applications, information property lists are provided in files, not in 'plist' resources. However, the Mac OS X application packaging scheme known as the bundle is not addressed in this book.

The Mac OS 8/9 Finder ignores 'plist' resources.

## An Application's Required Resources

The Mac OS 8/9 Finder requires that your application provide the following:

- A **signature resource**, which enables the Finder to identify and start up your application when a user double clicks a document created by your application.
- **Icon resources**, which represent your application and any documents it creates to the user.
- **File reference resources**, which link icons with the file types they represent.
- A **bundle resource**, which groups signature, icon, and file reference resources together.
- A **'SIZE' resource** (see Chapter 2).

Other resources that should be provided by your application for Mac OS 8/9 are:

- **Version resources**, which allow users to ascertain the version of your application.
- A **help resource**, which is used by the Finder to display your application's customized balloon help message.

Assuming that the application's 'p1st' resource contains the necessary information, Mac OS X does not utilize the signature, file reference, bundle, or version resources. The help resource is irrelevant on Mac OS X.

## Application Signature, File Creator, and File Types

### Application Signature

Your application's **signature** is a unique four-character sequence, which must not conflict with that of any other application, and which the Finder uses to identify your application.

#### NOTE

To ensure uniqueness, developers are required to register their application's signature with Apple Computer, Inc, at Macintosh Developer Technical Support.

To provide its signature, your application must include a special resource whose resource type is the application's signature and whose resource ID is 0.

### Creating an Application Signature Resource Using Resorcerer

Resorcerer allows you to create an application signature resource within its bundle resource editing window (see Fig 5). Fig 1 shows an application signature resource being created using Resorcerer.

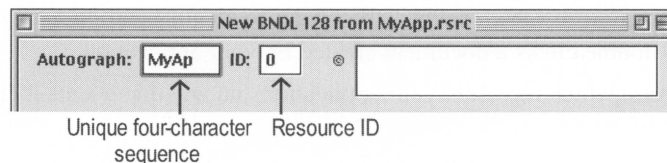


FIG 1 - CREATING A SIGNATURE RESOURCE USING RESORCERER

## File Creator and File Type

When an application creates a document, it assigns that document a **creator** and a **file type**. Your application should set its own signature as the creator of the documents it creates. The creator field of the application file itself should contain the application's own signature.

### Use of the Creator by the Finder

The Finder reads the creator field of a document file when the user double clicks on the file's icon or selects it and chooses Open from the Finder's File menu (or, on Mac OS 8/9 only Print from the Finder's File menu). Having obtained the creator, the Finder then searches for an application with a signature of that name and, if it finds the application, calls the Process Manager to start it up. The Finder then passes to your application the information it needs to open or print the document via an Apple event.

#### NOTE

Note that in this and other references to your application receiving requests to open and print documents, the assumption is made that your application supports the receipt and handling of required Apple events (see Chapter 10).

## File Type

The file type can be a type especially defined for your application or it can be one of the existing general types, some of which are as follows:

<i>File Type</i>	<i>Description</i>
'APPL'	Launchable application.
'DRVR'	Driver.
'FFIL'	File for storing fonts.
'PICT'	QuickDraw picture.
'PRER'	Printer driver.
'TEXT'	Stream of ASCII characters.
'appe'	Background only application.
'ffil'	Font.
'pref'	Preferences file.
'sfil'	Sound.
'ttro'	SimpleText read-only file.

Your application's file type must be 'APPL'.

**NOTE**

Apple reserves the use of all signatures and file types whose names contain only lowercase and non-alphabetic characters. Your signature and file type created especially for your application must each contain at least one uppercase character. Like signatures, file types must be registered with Apple.

**Use of the File Type by the Finder**

Another way for a user to open a document created by your application, as well as a document not created by your application but which is of a file type *supported* by your application, is to select its icon and drag the selected icon to your application's icon. If the document's file type is supported by your application, the Finder calls the Process Manager to launch your application and then sends your application a required Apple event containing the information it needs to open the document.

**Use of File Type by Your Application**

Your application also relies on file types to determine which files to allow the user to open when your application is running. When your application calls Navigation Services to open a file, your application supplies either a list of the file types that your application can open or a filter function for those types. The Open dialog then displays files of the specified types only. (See Chapter 18.)

**Icons for the Finder**

If you do not supply your own icons, the Finder uses its own default application and document icons for display. Fig 2 shows some of the Finder's default icons.



**FIG 2 - DEFAULT ICONS**

Although default icons are available, you should design and create your own icons for all the file types associated with your application, such as

- The application file.
- Documents created by your application.
- Stationery pads created by users from your application's documents. (Stationery pads are files the user creates to serve as templates for other documents.)



## The Icon Family

An **icon family** is a collection of icons intended to represent a single file type. The provision of a family of icon types, rather than just one icon type, enables the Finder to automatically select the appropriate family member to display depending on the icon size specified by the user and the bit depth of the display device.

Prior to Mac OS 8.5, the following icons comprised the icon family for a single file:

<i>Icon</i>	<i>Size (Pixels)</i>	<i>Resource in Which Defined</i>
Large black-and-white icon (1-bit) and mask	32-by-32	Icon list ('ICN#').
Small black-and-white icon (1-bit) and mask	16-by-16	Small icon list ('ics#')
Mini black-and-white icon (1-bit) and mask	12-by-16	Mini icon list ('icm#')
Large color icon with 4 bits of color data per pixel	32-by-32	Large 4-bit color icon ('ic14')
Small color icon with 4 bits of color data per pixel	16-by-16	Small 4-bit color icon ('ics4')
Mini color icon with 4 bits of color data per pixel	12-by-16	Mini 4-bit color icon ('icm4')
Large color icon with 8 bits of color data per pixel	32-by-32	Large 8-bit color icon ('ic18')
Small color icon with 8 bits of color data per pixel	16-by-16	Small 8-bit color icon ('ics8')
Mini color icon with 8 bits of color data per pixel	12-by-16	Mini 8-bit color icon ('icm8')

All of these icons use 1-bit masks, which are stored with the 'ICN#', 'ics#', and 'icm#' resources. The Finder uses the mask to crop the icon's outline into the background and then draws the icon into this shape. For this reason, the mask must be exactly the same shape as the icon (see Fig 3).

Note that the term “icon list” applying to the names of the black-and-white icon resources is somewhat of a misnomer in that you can define only two images in these resources: the icon and its mask.

The mini icon is of doubtful utility in the Carbon era and will not be considered further.



## Huge Icons, 32-Bit Icons, and Deep Masks

Mac OS 8.5 introduced the following:

- Huge (48-by-48 pixels) icons ('ich#', 'ich4', 'ich8', and 'ih32').
- 32-bit small, large, and huge icons ('is32', 'il32', and 'ih32').
- 8-bit masks for the 32-bit icons ('s8mk', 'l8mk', and 'h8mk'). These “deep” masks support 256 different levels of transparency.

The bundle resource, however, does not support huge icons, 32-bit icons, or 8-bit masks. On Mac OS 8/9, therefore, you cannot specify these icons for your application or its documents. You can, however include them in an 'icns' resource (see below) for Mac OS X.

## Thumbnail Icons, the 'icns' Resource, and Mac OS X

For Mac OS X, you should provide 128-by-128 pixel, 32-bit, **thumbnail** icons ('it32') icons. The associated mask ('t8mk') depth is 8-bits.

This icon should be included, along with other required icons, in an 'icns' resource. (The 'icns' resource was introduced with Mac OS 8.5 as a means of providing a single source for all icon data. Combining all icon data into a single resource type speeds up icon fetching and simplifies resource management.) The ID of the 'icns' resource must be included in the information property list in your application's 'plst' resource.

Mac OS X can generate icons of various sizes by scaling the thumbnail. Nevertheless, if you need to preserve fine details at smaller resolutions, you may provide large and small icons, in addition to thumbnail icons, in your 'icns' resources. In this case, the system will use the best available icon for the display size required.

## Creating Icon Resources

Unless you are using Resorcerer Version 2.4 or later, it will not be possible to use that application to create huge icons, any 32-bit icons, the thumbnail icons required for Mac OS X, or 'icns' resources. In these circumstances, a reasonable methodology is to

- Use Resorcerer to create the icons that will be used when the application runs on Mac OS 8/9.
- Use the shareware program Iconographer to create the icons and 'icns' resource that will be used when the application runs on Mac OS X.

## Creation Using Resorcerer

Fig 3 shows large and small 1-bit, 4-bit, and 8-bit icons being created in Resorcerer.

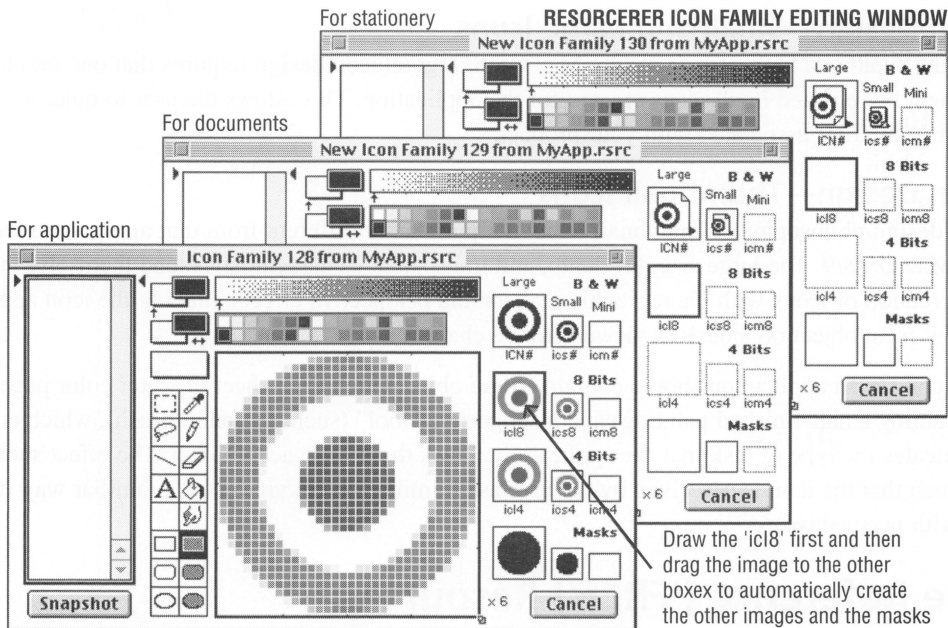


FIG 3 - THREE ICON FAMILIES BEING CREATED USING RESORCERER

## Creation Using Iconographer

Fig 4 shows an application's icons being created using Iconographer. You can copy the 'icons' resource in the resource fork of the file created by Iconographer to your application's resource file.

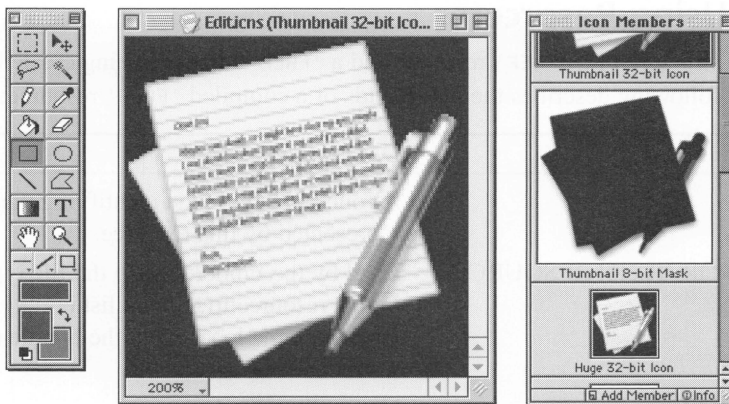


FIG 4 - AN APPLICATION'S ICON BEING CREATED USING ICONOGRAPHER

## Icon Design—Small and Large Icons

For the small and large icons used by Mac OS 8/9, good icon design requires that one graphic element be repeated in all icons created for the application. This allows the user to quickly identify the files associated with your product.

## Icon Design—Thumbnail Icons

The design philosophy for thumbnail icons is significantly different from that applying to icons for Mac OS 8/9. The large size, bit-depth, and transparency characteristics lend themselves to the creation of icons with photographic realism and perspective effects, making the icon appear as if it is an object on a desk as viewed from a chair.

An icon for an application should contain a base object (such as, a sheet of water color paper containing a half-finished painting) and a supportive “tool” (such as a paint brush), which communicates the type of task that the application allows the user to accomplish. The effect should be such that the icon is perceived by the user as a familiar object viewed in a familiar way (that is, with perspective).

## File Reference ('FREF') Resources

File reference ('FREF') resources associate your application's icons with file types created and supported by your application, allowing users to open documents supported by your application by dragging their icons to your application's icon.

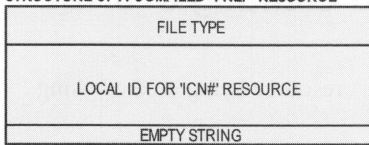
You create separate 'FREF' resource for your application file and for each file type that your application can open.

## Structure of the 'FREF' Resource and Creating a 'FREF' Resource Using Resorcerer

Fig 5 shows the structure of a 'FREF' resource and a 'FREF' resource being created using Resorcerer. The following describes the main fields of a compiled 'FREF' resource:

<i>Field</i>	<i>Description</i>
FILE TYPE	A four-character code identifying the type of file represented by this resource.
LOCAL ID FOR 'ICN#' RESOURCE	Used by the Finder to map the file type specified in this resource to an icon list ('ICN#') resource with the same local ID in the bundle ('BNDL') resource.
EMPTY STRING	Not implemented.

## STRUCTURE OF A COMPILED 'FREF' RESOURCE



File type - stationery. \_\_\_\_\_  
Maps to 'ICN#' resource with local ID 2 in bundle resource (see Fig 5).

File type - document. \_\_\_\_\_  
Maps to 'ICN#' resource with local ID 1 in bundle resource (see Fig 5).

File type - application. \_\_\_\_\_  
Maps to 'ICN#' resource with local ID 0 in bundle resource (see Fig 5).

For the stationery file type, use the file type of the document upon which the stationery is based but replace the first letter of the file type with a lowercase s, as shown in this example.

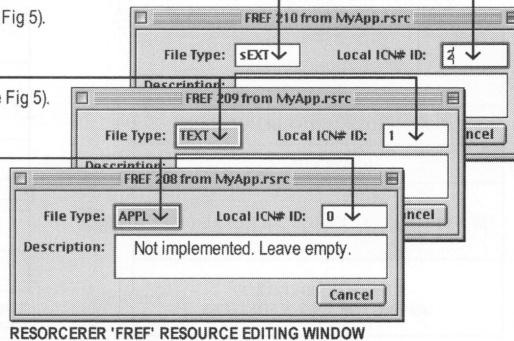


FIG 5 - STRUCTURE OF A COMPILED 'FREF' RESOURCE AND CREATING A 'FREF' RESOURCE USING RESORCERER

## Use of 'FREF' Resources by the Finder

The Finder maintains a list of your 'FREF' resources. When, for example, the user drags a document icon to your application icon, the Finder checks the list and, if the document's file type appears in this list, launches your application with a request, passed via a required Apple event, to open that document.

You can define 'FREF' resources for file types your application supports but for which it does not provide icons. This allows users to launch your application by dragging the icons representing documents of this type to your application icon. For example, you could create a 'FREF' resource for the document file type 'ttrt', which is used by documents that have SimpleText as their creator. (The Finder uses SimpleText's icon family resources for these documents.) The user can then open these documents in your application by dragging the document icon to your application's icon.

## The Bundle ('BNDL') Resource

A bundle ('BNDL') resource associates all of the resources (signature, icons, and file reference) used by the Finder for your application.

When the Finder displays your application on the desktop for the first time, it determines whether the application has a 'BNDL' resource by checking the catalog file. If the Finder finds a 'BNDL' resource, it installs the information from the 'BNDL' resource and its associated resources into the Mac OS 8/9 desktop database and uses that information to display icons for your application's file types. If the Finder does not find a 'BNDL' resource, it displays your application using the default icons.

## Structure of the 'BNDL' Resource and Creating a 'BNDL' Resource Using Resorcerer

Fig 6 shows the structure of a 'BNDL' resource and a 'BNDL' resource being created using Resorcerer.

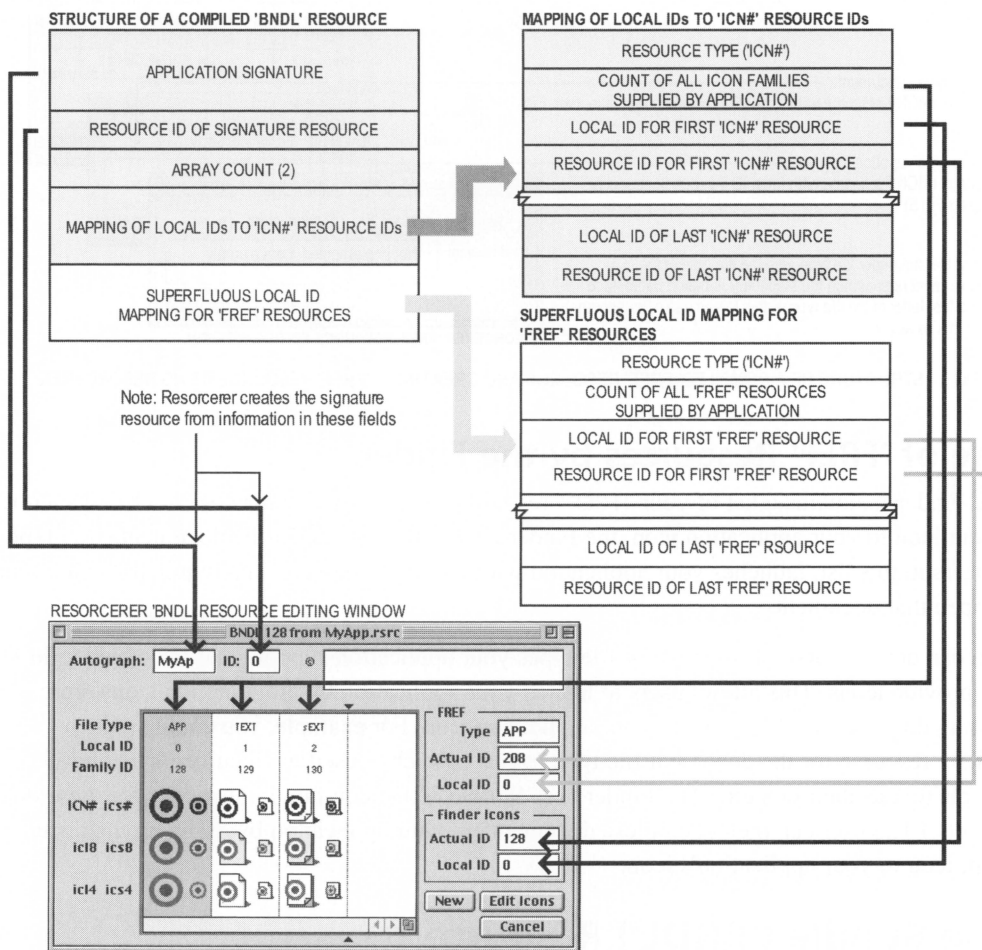


FIG 6 - STRUCTURE OF A COMPILED 'BNDL' RESOURCE AND CREATING A 'BNDL' RESOURCE USING RESORCERER

The following describes the main fields of a compiled 'BNDL' resource:

<i>Field</i>	<i>Description</i>
APPLICATION SIGNATURE	Identifies the application to the Finder.
RESOURCE ID OF THE SIGNATURE RESOURCE	Signature resource ID. (Always 0.)
LOCAL ID OF FIRST 'ICN#' RESOURCE	Must match the local ID assigned to the 'ICN#' resource within a 'FREF' resource.
RESOURCE ID OF FIRST 'ICN#' RESOURCE	To visually represent files of the type described in the 'FREF' resource that contains the local ID in the preceding field, the Finder uses the appropriate member of the icon family with the same resource ID as this 'ICN#' resource.
LOCAL ID OF FIRST 'FREF' RESOURCE	A local ID for the 'FREF' resource relating to this file type. (Superfluous.)
RESOURCE ID OF FIRST 'FREF' RESOURCE	The resource ID of the 'FREF' resource relating to this file type. (Superfluous.)

Note that you also assign local IDs to 'FREF' resources within the 'BNDL' resource. This assignment is superfluous because the Finder does not map these local IDs to any other resources. It was implemented for the earliest versions of the system software, and it remains this way today for backward compatibility.

## Resource IDs, Local Ids, and the Desktop Database

As shown in Fig 6, you must assign local IDs to your 'ICN#' resources within your 'BNDL' resources. You must ensure that, for all your file types for which you provide icons, these local IDs match the local IDs you assigned inside their corresponding 'FREF' resources.

In the desktop database, the Finder rennumbers the resource IDs that you have assigned to your resources to avoid conflicts with the resources of other applications. Therefore, the 'BNDL' resource has to rely on these local IDs to map 'ICN#' resources to their 'FREF' resources, that is, the 'BNDL' resource uses the local ID you assign to an 'ICN#' resource to map it to the 'FREF' resource that has specified the same local ID. For example, the 'FREF' resource with resource ID 208 in Fig 5 shows that the file type 'APPL' is assigned a local ID of 0. In Fig 6, you will see that local ID 0 is assigned to the 'ICN#' resource with resource ID 128. This maps the icon defined by this resource to the application file.

Fig 7 illustrates how the 'BNDL' resource uses local IDs to map 'ICN#' resources to 'FREF' resources.

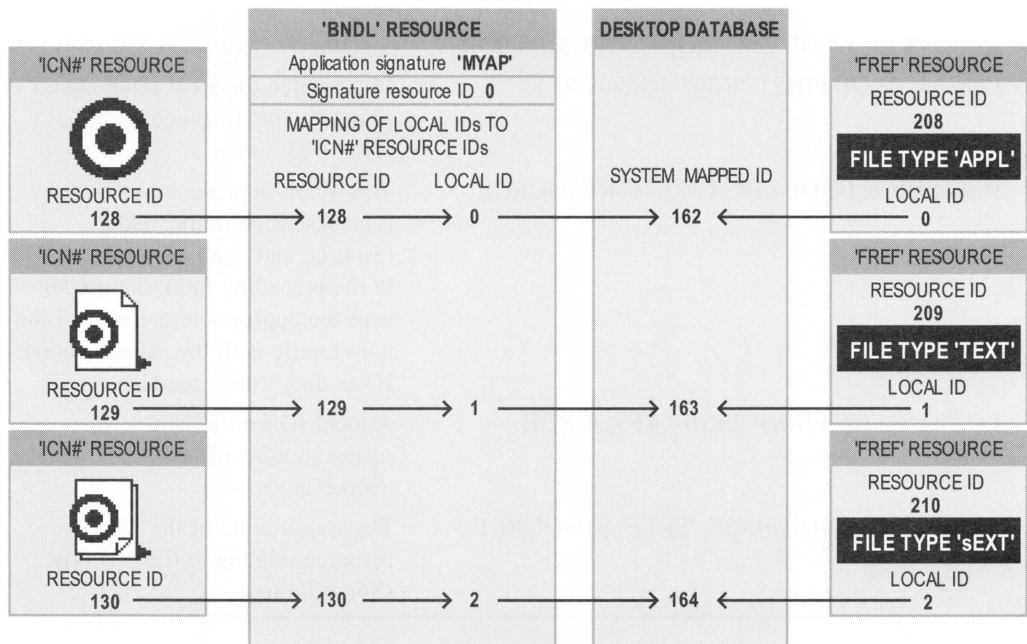


FIG 7 - HOW THE BUNDLE RESOURCE LINKS 'ICN#' RESOURCES AND 'FREF' RESOURCES

In Fig 7, the application file's 'ICN#' resource has a resource ID of 128 while its 'FREF' resource has a resource ID of 208. In an actual application, it is best if you assign the same resource ID to a file's 'FREF' resource that you assign to its 'ICN#' resource. This makes code maintenance easier.

## Informing the Finder that Your Application has a 'BNDL' Resource

You alert the Finder that your application has a 'BNDL' resource by setting a bit in the file's Finder flags field (see below).

## The Version ('vers') Resource

You use version ('vers') resources to supply version information to the Finder. There are two ways that the Finder displays this information:

- In Finder list views, the version number (short string) is displayed in the Version column.
- The version message (long string) is displayed in the Finder's Get Info window on Mac OS 8/9 and in the Finder's Show Info window on Mac OS X.



You can use 'vers' resources to assign version information to an individual file and, if it is a part of a larger collection of files, to the entire superset of files. The 'vers' resource with ID 1 specifies the version of the file; the 'vers' resource with ID 2 specifies the version of the set of files.

## Structure of the 'vers' Resource and Creating a 'vers' Resource Using Resorcerer

Fig 8 shows the structure of a 'vers' resource and a 'vers' resource being created using Resorcerer.

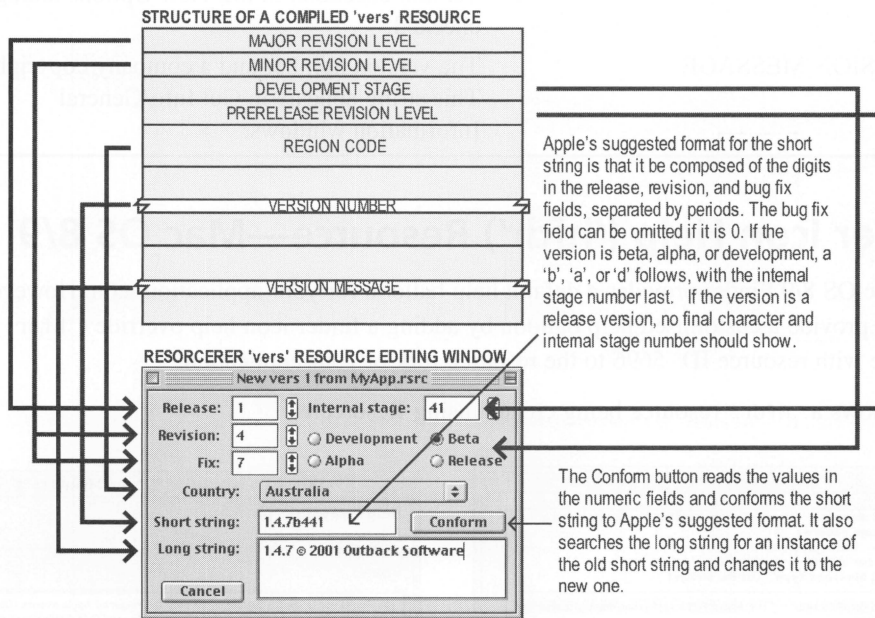


FIG 8 - STRUCTURE OF A COMPILED 'vers' RESOURCE AND CREATING A 'vers' RESOURCE USING RESORCERER

The following describes the main fields of a compiled 'vers' resource:

Field	Description
MAJOR REVISION LEVEL	Major revision level in binary coded decimal format. Although the Finder does not display it anywhere, you can store this information here.
MINOR REVISION LEVEL	Major revision level in binary coded decimal format. Although the Finder does not display it anywhere, you can store this information here.

<i>Field</i>	<i>Description</i>
DEVELOPMENT STAGE	The values in this field indicate one of four development stages: development, alpha, beta, or released.
PRERELEASE REVISION LEVEL	The version if the software is still in prerelease.
REGION CODE	The script system for which this version of the software is intended.
VERSION NUMBER	The version number. This string appears in the Version column in list view windows when the Version checkbox in the View Options dialog is checked.
VERSION MESSAGE	The version number and a company copyright. This string appears in Get Info/General Information windows.

## Finder Icon Help ('hfdR') Resource—Mac OS 8/9

The Mac OS 8/9 Finder provides a default help balloon for your application icon. However, you can provide a customised help balloon by adding a finder icon help override ('hfdR') resource with resource ID -5696 to the resource fork of your application.

Fig 9 shows a 'hfdR' resource being created using Resorcerer.

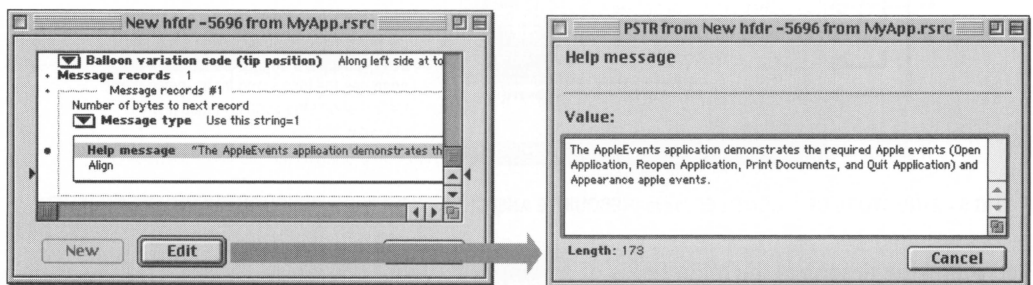


FIG 9 - CREATING AN 'hfdR' RESOURCE USING RESORCERER

## Missing Application and Application-Missing Resources—Mac OS 8/9

Missing application and application missing string resources are not supported on Mac OS X. Accordingly, the following is applicable to Mac OS 8/9 only.

## Missing Application and Application Missing

On Mac OS 8/9, if the user tries to open a file created by an application that is missing in circumstances where the user has selected Translate documents automatically off in the File Translation tab of the File Exchange control panel, or if the user attempts to open a file that he/she should not be able to open (such as a Preferences file), the Finder responds by displaying a movable modal alert. The contents of that alert depend on the following factors:

- If the file is a document file created by an application that is missing, whether the resource fork of that file contains a **missing application name string resource**, that is, a 'STR ' resource with a resource ID of -16396.
- If the file is a file that is not meant to be opened, whether the file's resource fork contains an **application-missing string resource**, that is, a 'STR ' resource with ID -16397.

If the Finder cannot find the document's creator on any mounted volume, it looks first for the application-missing string resource. If it cannot find an application-missing string resource, it then searches for a missing-application name string resource.

### Missing Application

Assuming that the document's name is "Document A," the alert in Fig 10 is displayed if the file does not contain a missing application name string resource and either the document is not of type 'TEXT' or 'PICT' or the document is of type 'TEXT' or 'PICT' and SimpleText is not available. If the document is of type 'TEXT' or 'PICT' and SimpleText is available, the alert in Fig 11 is displayed.

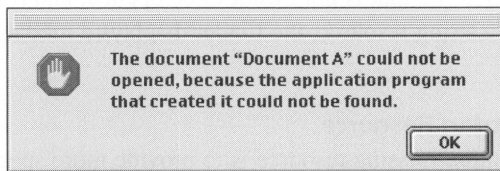


FIG 10 - THE DEFAULT MISSING APPLICATION MODALALERT BOX

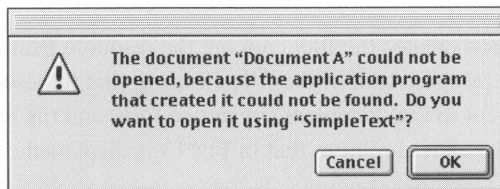
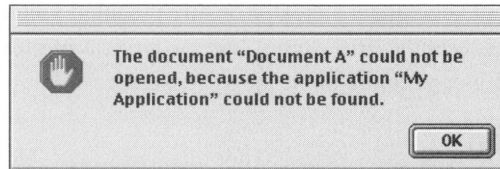


FIG 11 - THE MISSING APPLICATION MODAL ALERT BOX - DOCUMENT IS A 'TEXT' OR 'PICT' FILE AND SIMPLETEXT IS AVAILABLE

### Missing Application Name String Resource

The purpose of the missing application name string resource is to provide more specific information to the user. That information is the name of the application that created the program. This is achieved by

- Including a 'STR ' resource containing your application's name in your application's resource fork.
- When your application saves a document for the first time, copying the resource from your application's resource fork to the resource fork of the newly created document, ensuring that its resource ID is -16396. If this resource is present in the document's resource fork, and the user attempts to open the document when your application is not present, a movable modal alert similar to that in Fig 12 is displayed.



**FIG 12 - THE MISSING APPLICATION MODAL ALERT BOX - DOCUMENT HAS A MISSING APPLICATION NAME STRING RESOURCE**

### Application-Missing

If the user attempts to open a file that is not meant to be opened, and if the file does not contain an application-missing string resource, the Finder displays a modal alert similar to that in Fig 10.

### Application-Missing String Resource

The purpose of the application-missing resource is to provide more specific information to the user. That information is an explanation of why the file cannot be opened. This is achieved by

- Including a 'STR ' resource containing the explanation in your application's resource fork.
- When your application creates the file, copying the resource from your application's resource fork to the resource fork of the file, ensuring that its resource ID is -16397. If this resource is present in the document's resource fork, and the user attempts to open the file, a movable modal alert similar to that in Fig 13 is displayed.

The file must have a unique signature that no application known to the finder is likely to have. This ensures that the Finder will display your message, instead of attempting to launch the application with that signature, when the user double clicks on the file's icon.

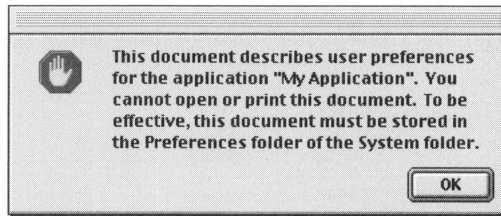


FIG 13 - AN APPLICATION MISSING MODAL ALERT BOX DISPLAYING A TYPICAL APPLICATION-MISSING STRING RESOURCE

## One 'STR' Resource Only

You supply *either* the missing-application name string resource *or* the application-missing string resource, but never both. For example, you would supply an application-missing string resource for your Preferences file (which the user should not be able to open) and a missing-application name string resource for documents that users should be able to open with your application.

## The 'plist' Resource and Information Property Lists

As previously stated:

- If your application includes a 'plist' (property list) resource, which itself includes a binary representation of an information property list containing the necessary information, the Mac OS X Finder extracts the information it requires from that list. In essence, the information property list is the interface through which your application communicates essential data to the Finder.
- If the 'plist' resource is empty, the Mac OS X Finder extracts the information provided by the signature, file reference, bundle, and version resources described in this chapter.

An information property list is a textual method of representing data that uses the Extensible Markup Language (XML) as the structuring medium, and which uses predefined keys for specifying information of interest to the Finder. This information is specified as key-value pairs (that is, as a dictionary). Standard keys are defined by Mac OS X for information such as the version string to be displayed in the Finder's Show Info dialog and the Finder defines keys for information such as the application's signature and type definitions for document types the application understands.

## Example Information Property List

The following is an example of an information property list for a simple non-bundled application which edits text files:

```

<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist SYSTEM "file://localhost/System/Library/DTDs/PropertyList.dtd">
<plist version="0.9">
<dict>
  <key>CFBundleInfoDictionaryVersion</key>
  <string>6.0</string>
  <key>CFBundleIdentifier</key>
  <string>com.Smith Software.MyApp</string>
  <key>CFBundleShortVersionString</key>
  <string>1.0.0</string>
  <key>CFBundleDevelopmentRegion</key>
  <string>English</string>
  <key>NSHumanReadableCopyright</key>
  <string>Copyright © 2001 Smith Software</string>
  <key>NSAppleScriptEnabled</key>
  <string>NO</string>
  <key>CFBundleName</key>
  <string>MyApp</string>
  <key>CFBundlePackageType</key>
  <string>APPL</string>
  <key>CFBundleSignature</key>
  <string>myaP</string>
  <key>CFBundleIconFile</key>
  <string>128</string>
  <key>CFBundleShortVersionString</key>
  <string>Version 1.0.0 May 2001</string>
  <key>CFBundleDocumentTypes</key>
  <array>
    <dict>
      <key>CFBundleTypeIconFile</key>
      <string>129</string>
      <key>CFBundleTypeName</key>
      <string>MyApp TEXT Document</string>
      <key>CFBundleTypeOSTypes</key>
      <array>
        <string>TEXT</string>
      </array>
      <key>CFBundleTypeRole</key>
      <string>Editor</string>
    </dict>
  </array>
</dict>
</plist>

```

The following describes the standard and Finder keys and associated values in this information property list:

<i>Standard Keys</i>	<i>Value</i>
CFBundleInfoDictionaryVersion	A string used to support future versioning of the format.
CFBundleIdentifier	A string, used by the preferences system to uniquely identify the application, in the form of a Java-style package name.

<i>Standard Keys</i>	<i>Value</i>
CFBundleVersion	A string containing a 'vers' resource-style (see Fig 8) version number.
CFBundleDevelopmentRegion	A string specifying the application's "native" region. In 'plst' resources, this serves the same purpose as the Region Code in a 'vers' resource.
NSHumanReadableCopyright	A string containing copyright information to be displayed in the Finder's Show Inspector dialog.
NSAppleScriptEnabled	A string specifying whether the application is AppleScript enabled.

<i>Finder Keys</i>	<i>Value</i>
CFBundleName	A string containing the name of the application.
CFBundlePackageType	A string containing, for applications, the file type APPL.
CFBundleSignature	A string containing the application's four-letter creator code.
CFBundleIconFile	A string containing the resource ID of the 'icns' resource containing the application's icon.
CFBundleShortVersionString	A string containing human-readable description of the version. This should be more than just the string that can be generated from the CFBundleVersion key.
CFBundleDocumentTypes	An array of type definitions for document types the application understands.
CFBundleTypeName	A string containing a name for this document type.
CFBundleTypeIconFile	A string containing the resource ID of the 'icns' resource containing this file type's icon.
CFBundleTypeRole	A string defining the application's role in relation to this document type. The role can be Editor, Viewer, or None.
CFBundleTypeOSTypes	An array of strings containing the four-letter file type codes that map to this type.

## Creating the 'plst' Resource

You can create the complete 'plst' resource by simply copying the XML listing and pasting it into an empty 'plst' resource using Resorcerer.



## Application Launching by the Finder

The following describes how the Finder launches an application.

When the user double clicks your application icon, selects it and chooses Open from the Finder's File menu, or chooses it from the Mac OS 8/9 Apple menu, the Finder calls the Process Manager to launch your application. The Finder then sends your application a required Apple event (called an Open Application event) before relinquishing control to your application. In response to the Open Application event, your application should then perform its usual startup actions, such as opening an untitled document window.

When the user double-clicks on the icon for a document created by your application, or selects one or more document icons and chooses Open from the Finder's File menu or chooses Print from the Mac OS 8/9 File menu, the Finder reads the creator field of each selected file to find the document's creator. If a document's creator matches your application's signature, the Finder calls the Process Manager to launch your application, and then sends your application a required Apple event (called an Open Documents or (Mac OS 8/9 only) Print Documents event) before relinquishing control to your application. These events contain the name, or names, of the document, or documents, to open or (on Mac OS 8/9 only) print. Your application should then open the documents or print them, as appropriate.

When the user drags one or more document icons to your application's icon, the Finder determines whether to launch your application by comparing the document's file type (stored in the catalog file) with the list of the file types supported by your application. If the document's type appears in your application's 'FREF' resource or, where your application's 'plst' resource contains an information property list, in that information property list (Mac OS X only), the Finder calls the Process Manager to launch your application, and passes the name/s of the document/s to your application in a required Apple event (Open Documents event). Your application should then open the document.

If the user double clicks a document item while your application is already running, the Finder sends your application an Open Documents event.

## The Finder and the Catalog File

The catalog file, which maintains relationships between the files and directories on a volume, is of prime importance to the File Manager; however, information in the catalog file is also used by the Finder.

In the catalog file, information for files is stored in **file information** (FInfo) and **extended file information** (FXInfo) **structures** and information for directories is stored in **directory information** (DInfo) and **extended directory information** (DXInfo) structures. The Finder can

manipulate fields in file information, directory information, and extended directory information structures.

When your application creates a new file, it assigns file type and creator information to the relevant fields of the file's file information structure, see Chapter 18. The Finder manipulates the other fields of the file information structure.

The file information structure is as follows:

```
struct FInfo
{
    OSType fdType;    // Type of file.
    OSType fdCreator; // File's creator.
    UInt16 fdFlags;   // Finder flags (invisible, locked, stationery, etc).
    Point fdLocation; // File's location in folder. ({0,0} places item automatically.)
    SInt16 fdFldr;    // Folder containing file.
};
typedef struct FInfo FInfo;
```

For a file that has already been created, you can set the type, creator and flags fields using the File Manager function `FspSetFInfo`, having first called `FspGetInfo` to return the file information structure.

## Finder Flags

Individual bits of the `fdFlags` field of the file information structure may be examined and set using constants defined in the header file `Finder.h`. The bits of most interest to an application, and the associated constants, are as follows:

<i>Bit</i>	<i>Constant</i>	<i>Meaning When Set</i>
10	<code>kHasCustomIcon</code>	The file has a customised icon.
11	<code>kIsStationery</code>	The file is a stationery pad.  To support stationery pads, your application should check this bit for every document passed to it by the Finder and Navigation Services.
12	<code>kNameLocked</code>	The file cannot be renamed from the Finder (and, also, cannot have customised icons assigned to it).
13	<code>kHasBundle</code>	The file has a 'BNDL' resource.  If the <code>hasBundle</code> bit is set, the Finder checks the <code>hasBeenInited</code> flag. If the <code>hasBeenInited</code> bit is set, the Finder uses database information to display the file's icon. If the <code>hasBeenInited</code> bit is not set, the Finder copies the information from the bundle resource to the database and sets the <code>hasBeenInited</code> bit.

<i>Bit</i>	<i>Constant</i>	<i>Meaning When Set</i>
		(If the <code>hasBundle</code> bit is not set, the Finder displays the default icon for that file type.)
14	<code>kIsInvisible</code>	The file is invisible from the Finder and from Navigation Services.
15	<code>kIsAlias</code>	The file is an alias.

## Preferences, Temporary Items, and Trash Folders—Using FindFolder

The only system-related folders you are ever likely to need are the Preferences folder, the Temporary Items folder, and the Trash folder.

You can use the `FindFolder` function to get the volume reference number and directory ID of these folders. The following **folder type constants** are passed in the `folderType` parameter of `FindFolder` to specify the folder type:

<i>Constant</i>	<i>Value</i>	<i>Folder</i>
<code>kPreferencesFolderType</code>	'pref'	Preferences
<code>kTemporaryFolderType</code>	'temp'	Temporary items
<code>kTrashFolderType</code>	'trsh'	Trash

## Stationery Pads

### Stationery Pads and the Finder

If the user opens a stationery pad from the Finder, the Finder first checks the `isStationeryAware` bit in your application's 'SIZE' resource. If the `isStationeryAware` bit is set, the Finder informs your application that the user has opened a document and passes your application the name of the stationery pad. If the `isStationeryAware` bit is not set, the Finder *creates a new document* from the template and starts up your application, passing it the name of the *new* document.

### Stationery Pads and Navigation Services

Unlike the Finder, Navigation Services (see Chapter 18) always passes your application the stationery pad itself, not a copy of it, regardless of the setting of the `isStationeryAware` bit in

your application's 'SIZE' resource. This means that the user can mistakenly over-write the stationery pad by saving it without assigning it a new name, a danger that can be avoided by making your application stationery-aware.

The key step in making your application stationery-aware is to always checking the `kIsStationery` bit of a document before opening it. The following is an example function that takes a file system specification structure and returns `true` or `false` according to whether the file is a stationery document or not:

```
Boolean isStationeryDoc(FSSpec fileSSpec)
{
    OSErr osErr;
    FInfo fInfo;
    Boolean result;

    osErr = FSpGetFInfo(&fileSSpec,&fInfo);
    if(osErr == noErr)
        result = ((fInfo.fdFlags & kIsStationery) == kIsStationery);
    else
        result = false;

    return(result);
}
```

## Using Aliases

An **alias** is an object that represents another file, directory, or volume. Both the Finder and Navigation Services resolve aliases before passing them to your application. However, if your application opens a file or directory without going through the Finder or Navigation Services, your application should always call `ResolveAlias` just before opening the file.

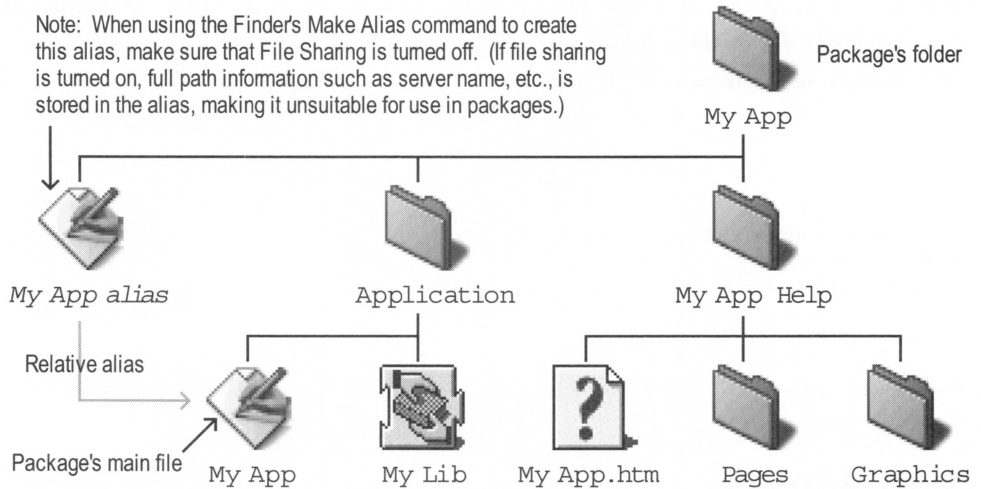
## Mac OS 9 Packages and Mac OS X Bundles

### Mac OS 9 Packages

Mac OS 9 introduced **packages**. Basically, a package is a folder with the “package bit” set. The package bit is bit 13 of the `frFlags` field of the directory information structure. This bit is the equivalent, for folders, of the bundle bit for files (bit 13 of the `fdFlags` field of the file information structure. Recall that the bundle bit for files determines how the file's icon is displayed.)

Any folder that has the package bit set, and which contains exactly one alias at its topmost level, will be treated by the Finder as a package.

Normally, a package comprises an application and a number of support files organized into sub-directories. There are no rules governing the arrangement of files and sub-directories other than there must be one alias at the topmost level. This alias points to some other file in the package's directory hierarchy. The file pointed to is called the "package's main file," and is ordinarily an application. An example of an application package is shown in Fig 14.



**FIG 14 - A PACKAGE (EXAMPLE)**

The Mac OS 8/9 Finder treats this package as if it were a file containing the 'BNDL', 'FREF', icon resources, etc., found in the package's main file. The package's folder is visually presented to the user as if it were a single double-clickable file, specifically, the package's main file. If, for example, a file is dragged over an application package's icon, the Finder will track the drag command as if the file was being dragged over the package's main file.

The major advantages of application packages are as follows:

- Since they cause the Finder to hide the contents of a package's folder from the user, they prevent accidental (or intentional) tampering with an application's support files.
- They simplify installation and uninstallation. All the user has to do is drag the application package onto a volume or, for uninstall, drag it to the trash.

Note also that the package's name and the package's main file name may differ. This allows the user to edit the name of the package without disturbing the name of the package's main file.

## Creating Packages

The Apple application PackageTool may be used to convert correctly formatted folders into packages and vice versa.

## Mac OS X Bundles

On Mac OS X, the option exists to package an application as a **bundle**. A bundle is a directory that contains, in a hierarchical organization, the application's executable and the resources required to support that code. One of the required contents of a bundle directory is a file containing the same XML code as would be contained in the 'plst' resource in a non-bundled version of the application.

A bundle can be presented to the user as a directory. However, as is the case with Mac OS 9 packages, if bit 13 of the frFlags field of the directory information structure is set, the Finder presents the bundle directory to the user as if it were a single file.

Packaging applications as bundles is not addressed in this book.

## Relevant Constants, Data Types, and Functions

### Constants

#### Finder Flags

kIsOnDesk	= 0x1
kColor	= 0xE
kIsShared	= 0x40
kHasBeenInitd	= 0x100
kHasCustomIcon	= 0x400
kIsStationary	= 0x800
kNameLocked	= 0x1000
kHasBundle	= 0x2000
kIsInvisible	= 0x4000
kIsAlias	= 0x8000

#### Folder Type Constants

kTrashFolderType	= FOUR_CHAR_CODE('trsh')
kPreferencesFolderType	= FOUR_CHAR_CODE('pref')
kTemporaryFolderType	= FOUR_CHAR_CODE('temp')

## Data Types

### File Information Structure

```
struct FInfo
{
    OSType fdType;    // Type of file.
    OSType fdCreator; // File's creator.
```

```

    UInt16 fdFlags;    // Finder flags (invisible, locked, stationery, etc).
    Point  fdLocation; // File's location in folder. ({0,0} places item automatically.)
    SInt16 fdFldr;     // Folder containing file.
};
typedef struct FInfo FInfo;

```

## Directory Information Structure

```

struct DInfo
{
    Rect    frRect;      // Folder's window bounds.
    UInt16 frFlags;      // Finder flags (invisible, locked, etc).
    Point  frLocation;   // Folder location. ({0,0} places item automatically.)
    SInt16 frView;       // Reserved. (Set to 0.)
};
typedef struct DInfo DInfo;

```

## Functions

```

OSErr FSpGetFInfo(const FSSpec *spec, FInfo *fndrInfo);
OSErr FSpSetFInfo(const FSSpec *spec, const FInfo *fndrInfo);
OSErr ResolveAliasFile(FSSpec *theSpec, Boolean resolveAliasChains, Boolean *targetIsFolder,
    Boolean *wasAliased);
OSErr FindFolder(short vRefNum, OSType folderType, Boolean createFolder, short *foundVRefNum,
    long *foundDirID);

```

## Demonstration Programs

As previously stated, this chapter should be read in conjunction with Chapter 10. The resources for the demonstration program in this chapter include a signature resource, icon resources, 'FREF' resources, a 'BNDL' resource, a 'vers' resource, a 'hfdR' resource, and a 'plst' resource containing an information property list.

## Missing Application Name String and Application-Missing String ('STR ') Resources

The demonstration program in Chapter 18 shows how to copy a missing application name string resource to the resource fork of a document file.

The demonstration program in Chapter 19 shows how to copy an application-missing string resource to the resource fork of a Preferences file.

## Preferences, Temporary Items, and Trash Folders

The demonstration program in Chapter 19 demonstrates creating and accessing a preferences file in the Preferences folder.

The demonstration program in Chapter 18 demonstrates creating a temporary file in, and deleting it from, the Temporary Items folder.

The demonstration program in Chapter 18 demonstrates determining whether a file is in the Trash folder, or in a folder in the Trash folder.



## IN THIS CHAPTER

- **Introduction** 456
- **Apple Event Attributes and Parameters** 457
- **Data Structures Within Apple Events** 460
- **Handling Apple Events** 465
- **Required Apple Events—Contents and Required Action** 467
- **Main Apple Event Manager and Appearance Manager Constants, Data Types, and Functions Relevant to Required Apple Events and Appearance Manager Apple Events** 470
- **Demonstration Program AppleEvents** 472
- **Demonstration Program AppleEvents Comments** 487

## Introduction

**Apple events** are **high-level events** whose structure and interpretation are determined by the **Apple Event InterProcess Messaging Protocol (AEIMP)**. Applications typically use Apple events to request services and information from other applications and to provide services and information in response to such requests.

In the world of Apple events

- The **client application** is the application that initiates communication between two applications that support Apple events. It sends the Apple event that requests a service or information.
- The **server application** is the application that provides the requested service or information.

As an example, Fig 1 shows a client application (the Finder) sending an Apple event known as the Open Documents event to the server application (My Application) requesting the latter to open the documents named Document A and Document B. My Application responds by opening windows for the specified documents.

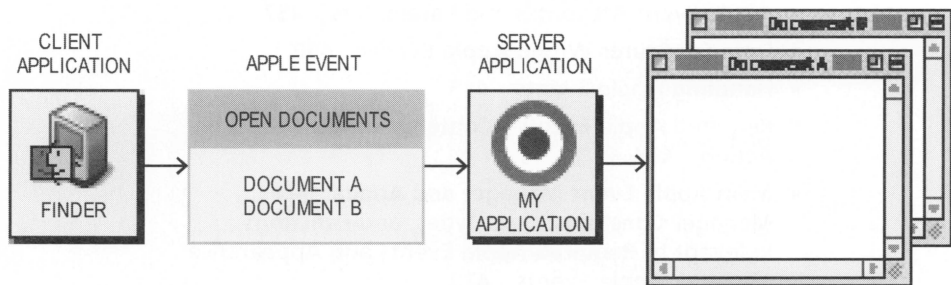


FIG 1 - CLIENT AND SERVER

An application can also send Apple events to itself, thus acting as both client and server.

Applications can rely on a vocabulary of standard Apple events, defined in the Apple Event Registry: standard suites, to identify Apple events and respond appropriately. The standard **suites** (a suite being a group of Apple events that are usually implemented together) include:

- The **required** suite, which consists of five Apple events that the Finder sends to applications. The required Apple events are:
  - Open Application.
  - Re-open Application.

- Open Documents.
- Print Documents.
- Quit Application.

The Finder uses the required Apple events as part of the mechanism for launching and terminating applications. Your application must support the required Apple events.

- The **core** suite, which consists of the basic Apple events, including Get Data, Set Data, Move, Delete and Save, that nearly all applications use to communicate.
- The **functional-area** suite, which consists of a group of Apple events that support a related functional area, and which include the Text suite and the Database suite.
- The **appearance** suite, which pertains to Mac OS 8/9 only, and which consists of four Apple events used to advise all foreground applications when one of the following changes has been made in the Mac OS 8/9 Appearance control panel:
  - Appearance. (Since the only Appearance ever made available by Apple is Platinum, this event will not be considered further.)
  - Large system font.
  - Small system font.
  - Views font.

Another important Apple event, of relevance on Mac OS X only, is the Show Preferences event. This event is sent to your application when the user chooses the Preferences item in the Mac OS X Application menu.

This chapter is primarily concerned with the required Apple events, the Appearance Manager Apple events, and the Show Preferences event, exploring the subject of Apple events only to the extent necessary to gain an understanding of the measures involved in supporting these events.

## Apple Event Attributes and Parameters

An Apple event comprises attributes and, possibly, parameters. Attributes identify the Apple event and denote the task to be performed. Parameters contain information to be used by the target application.

### Apple Event Attributes

An Apple event attribute is a structure that identifies, principally, the **event class**, **event ID**, and target application.

## Event Class

The event class identifies a group of related Apple events. It appears in the message field of the event structure for an Apple event (see Fig 2). For example

- The required Apple events have the value 'aevt' in the message field of their event structures. ('aevt' is represented by the constant kCoreEventClass.)
- The Appearance Manager Apple events have the value 'appr' in the message field of their event structures. ('appr' is represented by the constant kAppearanceEventClass.)

what	23	= kHighLevelEvent
message	Event Class	
when	Time event was posted	
where	Event ID	
modifiers	Undefined	

FIG 2 - CONTENTS OF AN EVENT STRUCTURE - HIGH LEVEL (APPLE) EVENT

## Event ID

The event ID identifies the particular event within the event class, uniquely identifying the Apple event and communicating the action the Apple event should perform. As shown in Fig 2, the event ID appears in the where field of the event structure for an Apple event. For example, for an Open Documents event, the where field will contain the value 'odoc' (which is represented by the constant kAEOpenDocuments.)

The following are the event IDs for the five required Apple events and the four Appearance Manager Apple events.

<i>Event ID</i>	<i>Value</i>	<i>Description</i>
kAEOpenApplication	'oapp'	Perform those tasks associated with the user opening the application.
kAEReopenApplication	'rapp'	Perform those tasks associated with the user "re-opening" the application.
kAEOpenDocuments	'odoc'	Open documents.
kAEPrintDocuments	'pdoc'	Print documents.
kAEQuitApplication	'quit'	Quit the application.
kAEAppearanceChanged	'thme'	Current appearance has changed. Action as required.
kAESystemFontChanged	'sysf'	Current system font has changed. Action as required.

Event ID	Value	Description
kAESmallSystemFontChanged	'ssfn'	Current small system font has changed. Action as required.
kAEViewsFontChanged	'vfnt'	Current views font has changed. Action as required.
kAEShowPreferences	'pref'	User has chosen the Prefences item in the Mac OS X Application menu.

### Target Application

In addition to the event class and event ID, every Apple event must include an attribute that specifies the target application’s address.

### Apple Event Parameters

An Apple event parameter is a structure containing data used by the target application. Apple events can use standard data types, such as strings of text, long integers, boolean values, and alias structures, for the data in their parameters.

There are various kinds of Apple event parameters, including direct parameters and additional parameters.

#### Direct Parameters

Direct parameters usually specify the data to be acted upon by the target application. For example, a list of documents is contained in the direct parameter of the Open Documents event.

#### Additional Parameters

Some Apple events also take additional parameters. The target application uses these additional parameters (for example, operands in an equation) in addition to the data specified in the direct parameter.

#### Required and Optional Parameters

All parameters are described as either **required parameters** or **optional parameters** in the Apple Event Registry: Standard Suites. Direct parameters are usually defined as required parameters.

### Attributes and Parameters in an Open Documents Apple Event

Fig 3 shows the major Apple event attributes and the direct parameter for the Open Documents event.



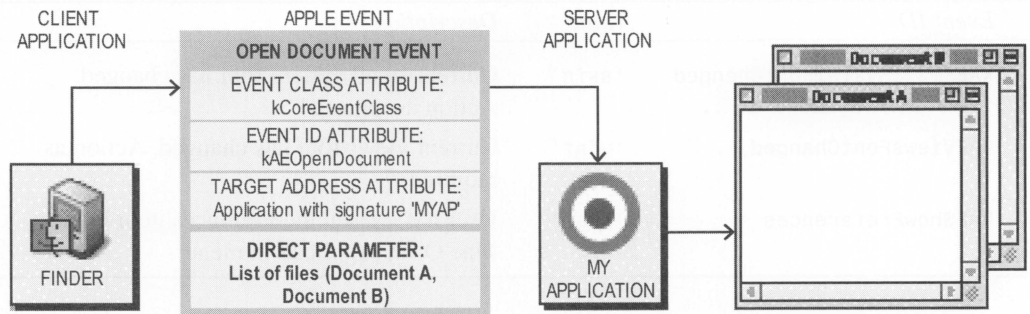


FIG 3 - OPEN DOCUMENTS APPLE EVENT - MAJOR ATTRIBUTES AND DIRECT PARAMETER

To process this event, the application My Application would use the `AEProcessAppleEvent` function, which uses the event class and event ID attributes to dispatch the event to its Open Documents handler. The Open Documents handler opens the documents specified in the direct parameter.

## Data Structures Within Apple Events

The Apple Event Manager constructs its own internal data structures to contain the information in an Apple event.

### Descriptor Structures

The Apple Event Manager uses **descriptor structures**, which you can think of as building blocks, to construct Apple event attributes and parameters. Descriptor structures comprise a handle to data and a **descriptor type**. The descriptor type identifies the type of data to which the handle refers:

```

struct AEDesc
{
    DescType      descriptorType; // Type of data.
    AEDataStorage dataHandle;     // Handle to data.
};
typedef struct AEDesc AEDesc;
  
```

### Carbon Note

In Carbon, the `dataHandle` field is opaque. You must use the accessor functions `AEGetDescData` and `AEGetDescDataSize` to access the data in this field.

The descriptor type is of type `DescType`, that is, a four-character code. The following are the codes for some of the major descriptor types, the constants used to represent them, and the kind of data they identify:

Descriptor Type	Value	Description of Data
typeChar	'TEXT'	Unterminated string.
typeType	'type'	Four-character code.
typeBoolean	'bool'	One-byte Boolean value.
typeLongInteger	'long'	32-bit integer.
typeAEList	'list'	List of descriptor structures.
typeAERecord	'reco'	List of keyword-specified descriptor structures.
typeAppleEvent	'aevt'	Apple event structure.
typeFSS	'fss '	File system specification.
typeKeyword	'keyw'	Apple event keyword.
typeNull	'null'	Nonexistent data (handle whose value is NULL).

Fig 4 illustrates the logical arrangement of two descriptor structures. The first specifies that the data handle refers to an unterminated string. The second specifies that the data handle refers to a four-character code, in this case 'aevt' (which is represented by the constant `kCoreEventClass`).

Data Type AEDesc	
Descriptor type:	typeChar
Data:	"Summary of Sales"

Data Type AEDesc	
Descriptor type:	typeType
Data:	Event Class kCoreEventClass

FIG 4 - TYPICAL DESCRIPTOR STRUCTURES

## Address Descriptor Structures

Every Apple event includes an attribute specifying the address of the target application. A descriptor structure that contains an application's address is called an **address descriptor structure**:

```
typedef AEDesc AEAddressDesc; // An AEDesc which contains addressing data.
```

## Keyword-Specified Descriptor Structures

The Apple Event Manager assembles the various descriptor structures into an Apple event. Your application cannot access the contents of the Apple event directly; rather, Event Manager



functions must be used to request each attribute and parameter by **keyword**. Keywords, which are four-character codes of type `AEKeyword`, are used to keep track of various descriptor structures.

The following are typical keywords and the constants used to represent them:

<i>Keyword</i>	<i>Value</i>	<i>Description</i>
<code>keyMissedKeywordAttr</code>	<code>'miss'</code>	For first required parameter remaining in an Apple event.
<code>keyDirectObject</code>	<code>'----'</code>	Direct parameter.

Keywords are associated with specific descriptor structures by means of keyword-specified descriptor structures:

```
struct AEKeyDesc
{
    AEKeyword descKey;      // Keyword.
    AEDesc     descContent; // Descriptor structure.
};
typedef struct AEKeyDesc AEKeyDesc;
```

## Descriptor Lists, AE Structures, and AppleEvent Structures

### Descriptor Lists

To extract data from an Apple event, you use Apple Event Manager functions to either copy data to a buffer, return a descriptor structure whose data handle refers to a copy of the data, or return **descriptor lists**, which are lists of descriptor structures. A descriptor list is a descriptor structure whose handle refers to a list of other descriptor structures (unless it is an empty list):

```
typedef AEDesc AEDescList; // List of descriptor structures.
```

Fig 5 illustrates the logical arrangement of the descriptor list that specifies the direct parameter of the Open Documents event shown in Fig 3.

This descriptor list provides the data for a keyword-specified descriptor structure.

### AE Structure

Keyword-specified descriptor structures can in turn be combined into an **AE structure**. An AE structure is a descriptor list of type `AERecord`:

```
typedef AEDescList AERecord; // List of keyword-specified descriptor structures.
```

The handle for a descriptor list of type `AERecord` refers to a list of keyword-specified descriptor structures that can be used to construct Apple event parameters.

Data Type AEDescList

Descriptor type:	typeAEList								
Data:	List of descriptor records <table><tr><td>Descriptor type:</td><td>typeAlias</td></tr><tr><td>Data:</td><td>Alias record for filename (Document A)</td></tr><tr><td>Descriptor type:</td><td>typeAlias</td></tr><tr><td>Data:</td><td>Alias record for filename (Document B)</td></tr></table>	Descriptor type:	typeAlias	Data:	Alias record for filename (Document A)	Descriptor type:	typeAlias	Data:	Alias record for filename (Document B)
Descriptor type:	typeAlias								
Data:	Alias record for filename (Document A)								
Descriptor type:	typeAlias								
Data:	Alias record for filename (Document B)								

FIG 5 - A DESCRIPTOR LIST FOR A LIST OF ALIASES

Apple Event Structure

An **Apple event structure** is another special descriptor list of type `AppleEvent`:

```
typedef AERecord AppleEvent; // List of attributes and parameters for Apple event.
```

An Apple event structure describes an Apple event. The data for an Apple event structure, like the data for an AE structure, consists of a list of keyword-specified descriptor structures. The difference between an AE structure and an Apple event structure is that the data in the latter is divided into two parts, the first for attributes and the second for parameters.

Passing Descriptor Lists, AE Structures, and Apple Event Structures to Apple Event Manager Functions

You can pass an Apple event structure to any Apple Event Manager function that expects an AE structure, and you can pass Apple event structures and AE structures, as well as descriptor lists and descriptor structures, to any Apple Event Manager functions that expect structures of data type `AEDesc`.

Example Complete Apple Event

Fig 6 shows an example of a complete Apple event. This is a data structure of type `AppleEvent` which contains a list of keyword-specified descriptor structures containing the attributes and parameters of an Open Documents event.

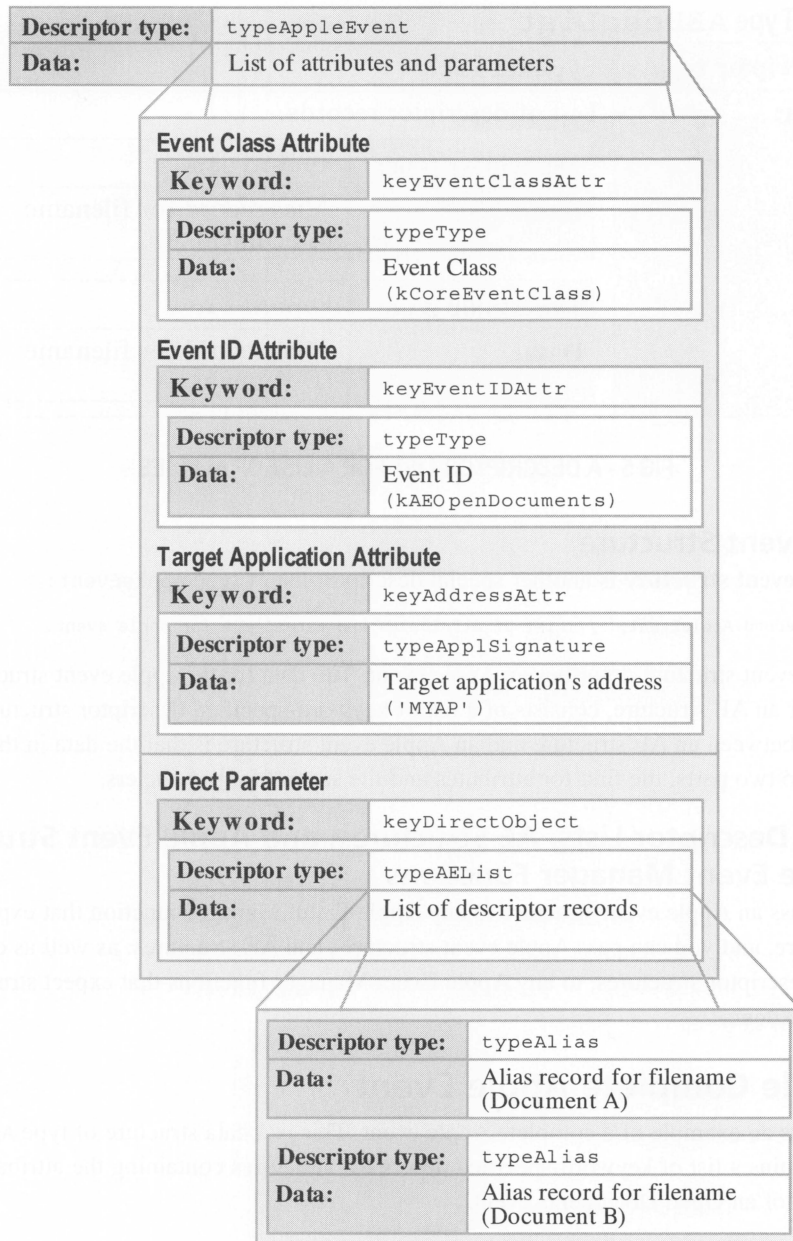


FIG 6 - AN APPLE (OPEN DOCUMENTS) EVENT

## Handling Apple Events

To request a service or information, a client application uses the Apple Event Manager to create and send an Apple event. To respond, a server application uses the Apple Event Manager to extract data from the attributes and parameters of the Apple event. In addition, and where necessary, the server application adds requested data to the reply event returned to the client by the Apple Event Manager.

As previously stated, your application should support the required Apple events sent by the Finder. Your application must therefore

- Set the `isHighLevelEventAware` flag in your application's 'SIZE' resource.
- Test for high-level events in the event loop. An Apple event (like all high-level events) is identified by a message class of `kHighLevelEvent` in the `what` field of the event structure.
- Use `AEProcessAppleEvent` to process the Apple events. `AEProcessAppleEvent` examines the data in the event class and event ID attributes so as to identify the Apple event and then calls the appropriate **Apple event handler** provided by your application.
- Provide handlers for the required Apple events in your application. Your Apple event handlers must extract the pertinent data from the Apple event, perform the requested action, and return a result.
- Use `AEInstallEventHandler` to install your Apple event handlers in an **Apple event dispatch table** for your application. The Apple event dispatch table is used by the Apple Event Manager to map Apple events to your application's handlers. Calls to `AEProcessAppleEvent` cause the Apple Event Manager to check the dispatch table and, if your application has installed a handler for the event, call the handler.

## Apple Event Handlers

Each Apple event handler must be a function that uses this syntax:

```
OSErr theEventHandler(AppleEvent *appleEvent, AppleEvent *reply, long handlerRefcon);
```

**appleEvent** The Apple event to handle. Your handler uses Apple Event Manager functions to extract any parameters and attributes from the Apple event and then perform the necessary processing.

**reply** The default reply provided by the Apple Event Manager.

**handlerRefcon** Reference constant stored in the Apple event dispatch table entry for the Apple event. Your handler can ignore this parameter if your application does not use the reference constant.

Apple event handlers must generally perform the following tasks:

- Extract the attributes and parameters from the Apple event.
- Check that all required parameters have been extracted.
- Perform the action requested by the Apple event.
- Dispose of any copies of the descriptor structures that have been created.
- Add information to the reply Apple event if requested.

## Extracting and Checking Data

You must use Apple Event Manager functions to extract the data from Apple events. The following are the main functions involved:

<i>Function</i>	<i>Description</i>
AEGetAttributePtr	Uses a buffer to return a copy of the data contained in an Apple event attribute. Used to extract data of fixed length or known maximum length.
AEGetParamDesc	Returns a copy of the descriptor structure or descriptor list for an Apple event parameter. Usually used to extract data of variable length, for example, to extract the descriptor list for a list of alias structures specified in the direct parameter of an Open Documents event.
AECountItems	Returns the number of descriptor structures in a descriptor list. Used, for example, to determine the number of alias structures for documents specified in the direct parameter of an Open Documents event.
AEGetNthPtr	Uses a buffer to return a copy of the data for a descriptor structure contained in a descriptor list. Used to extract data of fixed length or known maximum length, for example, to extract the name and location of a document from the descriptor list specified in the direct parameter of the Open Documents event.

## Data Type Coercion

You can specify the descriptor type in the resulting data from these functions. If this type is different from the descriptor type of the attribute or parameter, the Apple Event Manager attempts to coerce it to the specified type. In the direct parameter of the Open Documents event, for example, each descriptor structure in the descriptor list is an **alias structure** and each alias structure specifies a document to be opened. All your application usually needs to open a document is a **file system specification structure** (FSSpec) of the document. When you extract the descriptor structure from the descriptor list, you can request that the Apple Event Manager return the data to your application as a file system specification structure instead of an alias structure.

### Checking That All Required Parameters Have Been Retrieved

After extracting all known Apple event parameters, your handler should check that it has retrieved all the parameters that the source application considered to be required. To do this, determine whether the `keyMissedKeywordAttr` attribute exists. If this attribute does exist, your handler has not retrieved all the required parameters, and it should return an error.

### Performing the Requested Action and Returning a Result

When your application responds to an Apple event, it should perform the standard action requested by the event.

Your Apple event handler should always set its function result to either `noErr`, if it successfully handles the Apple event, or to a non-zero result code if an error occurs. When your handler returns a non-zero result code, the Apple Event Manager adds a `keyErrorNumber` parameter, containing the result code that your handler returns, to the reply Apple event.

### Disposing of Copies of Descriptor Structures

When your handler is finished with a copy of a descriptor structure created by `AEGGetParamDesc` and related functions, it should dispose of it by calling `AEDisposeDesc`.

## Required Apple Events—Contents and Required Action

Your application receives the five required Apple events from the Finder in these circumstances:

- If your application is not open and the user elects to open it from the Finder without opening or printing any documents (either by double clicking the application's icon, selecting the icon and choosing Open from the Finder's File menu, or choosing it from the Mac OS 8/9 Apple menu), the Finder calls the Process Manager to launch your application and then sends your application an Open Application event.
- If your application is already open and the user attempts to "open" it again, the Finder sends your application a Re-open Application event.
- If your application is not open and the user elects to open one of your application's documents from the Finder, the Finder calls the Process Manager to launch your application and then sends your application an Open Documents event.
- On Mac OS 8/9, if your application is not open and the user elects to print one of your application's documents from the Finder, the Finder calls the Process Manager to launch your application and then sends your application a Print Documents event. Your application should print the selected documents and remain open until it receives a Quit Application event from the Finder.



- If your application is open and the user elects to open or (on Mac OS 8/9 only) print any of your application's documents from the Finder, the Finder sends your application the Open Documents or (on Mac OS 8/9 only) Print Documents event.
- If your application is open and the user chooses Restart or Shut Down, the Finder sends your application the Quit Application event.

The Re-open Application event was introduced with MAC OS 8 to cater for a situation which could confuse inexperienced users. The specific situation is where the application is open but has no open windows. Because of the absence of a window, the user does not realise that the application is running, attempts to "open" it from the Finder, and then fails to notice the menu bar change. The intention of the Re-open Application event in such circumstances is to cause the application to open a window, providing more obvious visible evidence to the user that the application is, in fact, open.

The following is a summary of the contents of the required Apple events sent by the Finder and the actions they request applications to perform:

---

#### Open Application event

---

##### Attributes:

Event Class: kCoreEventClass  
 Event ID: kAEOpenApplication

**Parameters:** None.

**Requested Action:** Perform tasks your application normally performs when a user opens your application without opening or printing any documents, such as opening an untitled document window.

---



---

#### Re-open Application event

---

##### Attributes:

Event Class: kCoreEventClass  
 Event ID: kAEReopenApplication

**Parameters:** None.

**Requested Action:** If no windows are currently open, open a new untitled document window.



---

**Open Documents event**

---

**Attributes:**

Event Class: kCoreEventClass  
Event ID: kAEOpenDocuments

**Required parameters:**

Keyword: keyDirectObject  
Descriptor type: typeAEList  
Data: A list of alias structures for the documents to be opened.

**Requested Action:** Open the documents specified in the keyDirectObject parameter.

---

---

**Print Documents event**

---

**Attributes:**

Event Class: kCoreEventClass  
Event ID: kAEPrintDocuments

**Required parameters:**

Keyword: keyDirectObject  
Descriptor type: typeAEList  
Data: A list of alias structures for the documents to be printed.

**Requested action:** Print the documents specified in the keyDirectObject parameter.

---

---

**Quit Application event**

---

**Attributes:**

Event Class: kCoreEventClass  
Event ID: kAEQuitApplication

**Parameters:** None

**Requested Action:** Perform any tasks that your application would normally perform when the user chooses Quit from the application's File menu. (Such tasks typically include releasing memory and asking the user whether to save documents which have been changed.)

---

Your application needs to recognize two descriptor types to handle the required Apple events: descriptor lists and alias structures.

As previously stated, in the event of an Open Documents or (on Mac OS 8/9 only) Print Documents event, you can retrieve the data that specifies the document as an alias structure, or you can request that the Apple Event Manager coerce the alias structure to a file system specification structure. The file system specification provides a standard method of identifying files.

## Main Apple Event Manager and Appearance Manager Constants, Data Types, and Functions Relevant to Required Apple Events and Appearance Manager Apple Events

### Constants

#### High Level Event

kHighLevelEvent = 23

#### Event Classes for Required Apple Event and Appearance Manager Apple Event

kCoreEventClass = FOUR\_CHAR\_CODE('aevt') Event class - required Apple events.  
 KAppearanceEventClass = FOUR\_CHAR\_CODE('appr') Event Class - Appearance Manager Apple events.

#### Event IDs for Required Apple Events

kAEOpenApplication = FOUR\_CHAR\_CODE('oapp') Event ID for Open Application event.  
 kAEReopenApplication = FOUR\_CHAR\_CODE('rapp') Event ID for Re-open Application Event.  
 kAEOpenDocuments = FOUR\_CHAR\_CODE('odoc') Event ID for Open Documents event.  
 kAEPrintDocuments = FOUR\_CHAR\_CODE('pdoc') Event ID for Print Documents event.  
 kAEQuitApplication = FOUR\_CHAR\_CODE('quit') Event ID for Quit Application event.

#### Event IDs for Appearance Manager Apple Events

kAESystemFontChanged = FOUR\_CHAR\_CODE('sysf') System font changed.  
 KAESmallSystemFontChanged = FOUR\_CHAR\_CODE('ssfn') Small system font changed.  
 kAEViewsFontChanged = FOUR\_CHAR\_CODE('vfnt') Views font changed.

#### Event ID for Show Preferences Apple Event (Mac OS X)

kAEShowPreferences = FOUR\_CHAR\_CODE('pref') Preferences menu item chosen

#### Keywords for Apple Event Attributes

keyMissedKeywordAttr = FOUR\_CHAR\_CODE('miss') First required parameter remaining in an Apple event.

#### Keywords for Apple Event Parameters

keyDirectObject = FOUR\_CHAR\_CODE('----') Direct parameter

## Apple Event Descriptor Types

```
typeAEList      = FOUR_CHAR_CODE('list')  List of descriptor structures.
typeWildcard    = FOUR_CHAR_CODE('****')  Matches any type.
typeFSS         = FOUR_CHAR_CODE('fss ')  File system specification.
```

## Result Codes

```
errAEDescNotFound    = -1701  Descriptor structure was not found.
errAEParmMissed      = -1715  Handler cannot understand a parameter
                           the client considers is required.
```

## Theme Font ID Constants

```
KThemeSystemFont      = 0
KThemeSmallSystemFont = 1
KThemeSmallEmphasizedSystemFont = 2
KThemeViewsFont       = 3
```

## Data Types

```
typedef FourCharCode AEEEventClass; // Event class for a high level event.
typedef FourCharCode AEEEventID;    // Event ID for a high level event.
typedef FourCharCode AEKeyword;     // Keyword for a descriptor structure.
typedef ResType DescType;           // Descriptor type.
typedef AEDesc AEDescList;          // List of descriptor structures.
typedef AEDescList AERecord;        // List of keyword-specified descriptor structures.
typedef AERecord AppleEvent;        // List of attributes and parameters for Apple event.
```

## Descriptor Structure

```
struct AEDesc
{
    DescType    descriptorType; // Type of data being passed.
    AEDataStorage dataHandle;    // Handle to data being passed.
};
typedef struct AEDesc AEDesc;
```

## Keyword-Specified Descriptor Structure

```
struct AEKeyDesc
{
    AEKeyword deskKey; // Keyword.
    AEDesc descContent; // Descriptor structure.
};
typedef struct AEKeyDesc AEKeyDesc;
```

## Functions

### Creating and Managing Apple Event Dispatch Tables

```
OSErr AEInstallEventHandler(AEEEventClass theAEEEventClass, AEEEventID theAEEEventID,
    AEEEventHandlerUPP handler, long handlerRefcon, Boolean isSysHandler);
```

### Dispatching Apple Events

```
OSErr AEProcessAppleEvent(const EventRecord *theEventRecord);
```

## Getting Data or Descriptor Structures out of Apple Event Parameters and Attributes

```
OSErr AEGgetParamDesc(const AppleEvent *theAppleEvent, AEKeyword theAEKeyword,
    DescType desiredType, AEDesc *result);
OSErr AEGgetAttributePtr(const AppleEvent *theAppleEvent, AEKeyword theAEKeyword,
    DescType desiredType, DescType *typeCode, Ptr dataPtr, Size maximumSize,
    Size *actualSize);
```

## Counting the Items in Descriptor Lists

```
OSErr AEGcountItems(const AEDescList *theAEDescList, long *theCount);
```

## Getting Items from Descriptor Lists

```
OSErr AEGgetNthPtr(const AEDescList *theAEDescList, long index, DescType desiredType, AEKeyword
    *theAEKeyword, DescType *typeCode, Ptr dataPtr, Size maximumSize, Size *actualSize);
```

## Deallocating Memory for Descriptor Structures

```
OSErr AEDisposeDesc(AEDesc *theAEDesc);
```

# Demonstration Program AppleEvents

```
// *****
// AppleEvents.c                                     CLASSIC EVENT MODEL
// *****
//
// This program:
//
// • Installs handlers for the required Apple events, Appearance Manager Apple events, and,
//   on Mac OS X only, the Show Preferences Apple event.
//
// • Responds to the receipt of required Apple events by displaying descriptive text in a
//   window opened for that purpose, and by opening simulated document windows as
//   appropriate. These responses result from the user:
//
// • Double clicking on the application's icon, or selecting the icon and choosing Open
//   from the Finder's File menu, thus causing the receipt of an Open Application event.
//
// • When the application is already open, double clicking on the application's icon, or
//   selecting the icon and choosing Open from the Finder's File menu, thus causing the
//   receipt of a Re-open Application event.
//
// • Double clicking on one of the document icons, selecting one or both of the document
//   icons and choosing Open from the Finder's File menu, or dragging one or both of the
//   document icons onto the application's icon, thus causing the receipt of an Open
//   Documents event.
//
// • On Mac OS 8/9, selecting one or both of the document icons and choosing Print from
//   the Finder's file menu, thus causing the receipt of a Print Documents event and, if
//   the application is not already running, a subsequent Quit Application event.
//
// • While the application is running, choosing Shut Down or Restart from the Finder's
//   Special menu, thus causing the receipt of a Quit Application event.
//
```

```
// • Responds to the receipt of Appearance Manager Apple events (Mac OS 8/9) and the Show
// Preferences Apple event (Mac OS X) by displaying descriptive text.
//
// The program, which is intended to be run as a built application rather than within
// CodeWarrior, utilises the following resources:
//
// • A 'plst' resource containing an information property list which provides information
//   to the Mac OS X Finder.
//
// • An 'icns' resource containing application and document icons for Mac OS X.
//
// • 'WIND' resources (purgeable, initially visible) for the descriptive text display window
//   and simulated document windows.
//
// • 'MBAR' and 'MENU' resources (preload, non-purgeable).
//
// • 'STR#' resources (purgeable) for displaying error messages using StandardAlert.
//
// • For Mac OS 8/9:
//
//   • 'ICN#', 'ics#', 'ics4', 'ics8', 'icl4', and 'icl8' resources (that is, an icon
//     family) for the application and for the application's documents. (Purgeable.)
//
//   • 'FREF' resources (non-purgeable) for the application and the application's 'TEXT'
//     documents, which link the icons with the file types they represent, and which allow
//     users to launch the application by dragging the document icons to the application
//     icon.
//
//   • The application's signature resource (non-purgeable), which enables the Finder to
//     identify and start up the application when the user double clicks the application's
//     document icons.
//
//   • A 'BNDL' resource (non-purgeable), which groups together the application's
//     signature, icon and 'FREF' resources.
//
//   • A 'hfdr' resource (purgeable), which provides the customised finder icon help
//     override help balloon for the application icon.
//
//   • A 'vers' resource (purgeable), which provides version information via the Show Info
//     window and the Version column in list view windows.
//
// • A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****
// ..... includes
#include <Carbon.h>
// ..... defines
```

```

#define rMenuBar          128
#define mFile             129
#define iQuit             12
#define rDisplayWindow    128
#define rDocWindow        129
#define rErrorStrings     128
#define eInstallHandler   1
#define eGetRequiredParam  2
#define eGetDescriptorRecord 3
#define eMissedRequiredParam 4
#define eCountDescripRecords 5
#define eCannotOpenFile   6
#define eCannotPrintFile  7
#define eCannotOpenWindow 8
#define eMenus            9
#define MIN(a,b)          ((a) < (b) ? (a) : (b))

// ..... global variables

WindowRef gWindowRef;
Boolean   gRunningOnX = false;
Boolean   gDone;
Boolean   gApplicationWasOpen = false;

// ..... function prototypes

void      main                (void);
void      doPreliminaries     (void);
void      doInstallAEHandlers (void);
void      doInstallAnAEHandler (AEEEventClass,AEEEventID,void *);
void      doEvents            (EventRecord *);
OSErr     openAppEventHandler (AppleEvent *,AppleEvent *,SInt32);
OSErr     reopenAppEventHandler (AppleEvent *,AppleEvent *,SInt32);
OSErr     openDocsEventHandler (AppleEvent *,AppleEvent *,SInt32);
OSErr     printDocsEventHandler (AppleEvent *,AppleEvent *,SInt32);
OSErr     quitAppEventHandler  (AppleEvent *,AppleEvent *,SInt32);
OSErr     sysFontChangeEventHandler (AppleEvent *,AppleEvent *,SInt32);
OSErr     smallSysFontChangeEventHandler (AppleEvent *,AppleEvent *,SInt32);
OSErr     viewsFontChangeEventHandler (AppleEvent *,AppleEvent *,SInt32);
OSErr     showPreferencesEventHandler (AppleEvent *,AppleEvent *,SInt32);
OSErr     doHasGotRequiredParams (AppleEvent *);
Boolean   doOpenFile          (FSSpec *,SInt32,SInt32);
Boolean   doPrintFile         (FSSpec *,SInt32,SInt32);
void      doPrepareToTerminate (void);
WindowRef doNewWindow         (void);
void      doMenuChoice        (SInt32);
void      doErrorAlert        (SInt16);
void      doDrawText          (Str255);
void      doConcatPStrings    (Str255,Str255);

// ***** main

void main(void)

```

```

{
    Rect            portRect;
    RGBColor        foreColor = { 0xFFFF,0xFFFF,0xFFFF };
    RGBColor        backColor = { 0x4444,0x4444,0x9999 };
    MenuBarHandle    menubarHdl;
    SInt32           response;
    MenuRef          menuRef;
    EventRecord      eventStructure;

    // ..... do preliminaries

    doPreliminaries();

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMenubar);
    if(menubarHdl == NULL)
        doErrorAlert(eMenus);
    SetMenuBar(menubarHdl);
    DrawMenuBar();

    Gestalt(gestaltMenuMgrAttr,&response);
    if(response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
        {
            DeleteMenuItem(menuRef,iQuit);
            DeleteMenuItem(menuRef,iQuit - 1);
            DisableMenuItem(menuRef,0);
        }

        gRunningOnX = true;

        EnableMenuCommand(NULL,KAEShowPreferences);
    }

    // ..... open a window

    if(!(gWindowRef = GetNewCWindow(rDisplayWindow,NULL,(WindowRef) -1)))
    {
        doErrorAlert(eCannotOpenWindow);
        ExitToShell();
    }

    SetPortWindowPort(gWindowRef);
    TextSize(10);
    TextFace(bold);
    RGBBackColor(&backColor);
    RGBForeColor(&foreColor);
    GetWindowPortBounds(gWindowRef,&portRect);
    EraseRect(&portRect);

```



```

// ..... install Apple event handlers

doInstallAEHandlers();

// ..... event loop

gDone = false;

while(!gDone)
{
    if (WaitNextEvent(everyEvent,&eventStructure,180,NULL))
        doEvents(&eventStructure);
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(64);
    InitCursor();
    FlushEvents(everyEvent,0);
}

// ***** doInstallAEHandlers

void doInstallAEHandlers(void)
{
    // ..... required Apple events

    doInstallAnAEHandler(kCoreEventClass,kAEOpenApplication,openAppEventHandler);
    doInstallAnAEHandler(kCoreEventClass,kAEReopenApplication,reopenAppEventHandler);
    doInstallAnAEHandler(kCoreEventClass,kAEOpenDocuments,openDocsEventHandler);
    doInstallAnAEHandler(kCoreEventClass,kAEPrintDocuments,printDocsEventHandler);
    doInstallAnAEHandler(kCoreEventClass,kAEQuitApplication,quitAppEventHandler);

    // ..... Appearance Manager Apple events

    doInstallAnAEHandler(kAppearanceEventClass,kAESystemFontChanged,sysFontChangeEventHandler);
    doInstallAnAEHandler(kAppearanceEventClass,kAESmallSystemFontChanged,
        smallSysFontChangeEventHandler);
    doInstallAnAEHandler(kAppearanceEventClass,kAEViewsFontChanged,viewsFontChangeEventHandler);

    // ..... Show Preferences Apple event

    if(gRunningOnX)
        doInstallAnAEHandler(kCoreEventClass,kAEShowPreferences,showPreferencesEventHandler);
}

// ***** doInstallAnAEHandler

void doInstallAnAEHandler(AEEventClass eventClass,AEEventID eventID,void *theHandler)
{
    OSErr osError;

```

```

osError = AEInstallEventHandler(eventClass,eventID,
                               NewAEventHandlerUPP((AEventHandlerProcPtr) theHandler),
                               0L,false);

if(osError != noErr)
    doErrorAlert(eInstallHandler);
}

// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    WindowPartCode partCode;
    WindowRef      windowRef;
    SInt32          menuChoice;

    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEProcessAppleEvent(eventStrucPtr);
            break;

        case mouseDown:
            partCode = FindWindow(eventStrucPtr->where,&windowRef);
            switch(partCode)
            {
                case inMenuBar:
                    menuChoice = MenuSelect(eventStrucPtr->where);
                    doMenuChoice(menuChoice);
                    break;

                case inDrag:
                    DragWindow(windowRef,eventStrucPtr->where,NULL);
                    break;

                case inContent:
                    if(windowRef != FrontWindow())
                        SelectWindow(windowRef);
                    break;

                case inGoAway:
                    DisposeWindow(windowRef);
                    break;
            }
            break;

        case keyDown:
            if((eventStrucPtr->modifiers & cmdKey) != 0)
                doMenuChoice(MenuEvent(eventStrucPtr));
            break;

        case updateEvt:
            BeginUpdate((WindowRef)eventStrucPtr->message);
            EndUpdate((WindowRef)eventStrucPtr->message);
            break;
    }
}

```

```
// ***** openAppEventHandler

OSErr openAppEventHandler(AppleEvent *appEvent, AppleEvent *reply, SInt32 handlerRefCon)
{
    OSErr    osError;
    WindowRef windowRef;

    gApplicationWasOpen = true;

    osError = doHasGotRequiredParams(appEvent);

    if(osError == noErr)
    {
        doDrawText("\pReceived an Apple event: OPEN APPLICATION.");
        doDrawText("\p    · Opening an untitled window in response.");

        windowRef = doNewWindow();
        SetWTitle(windowRef, "\puntitled");
    }

    return osError;
}

// ***** reopenAppEventHandler

OSErr reopenAppEventHandler(AppleEvent *appEvent, AppleEvent *reply, SInt32 handlerRefCon)
{
    OSErr    osError;
    WindowRef windowRef;

    osError = doHasGotRequiredParams(appEvent);

    if(osError == noErr)
    {
        doDrawText("\pReceived an Apple event: RE-OPEN APPLICATION.");
        doDrawText("\p    · I will check whether I have any windows open.");

        windowRef = GetWindowList();

        if((windowRef = GetNextWindow(windowRef)) == NULL)
        {
            doDrawText("\p    No windows are open, so I will open a window.");

            windowRef = doNewWindow();
            SetWTitle(windowRef, "\puntitled 1");
        }
        else
            doDrawText("\p    A window is open, so I won't open another.");
    }

    return osError;
}
```

```
// ***** openDocsEventHandler

OSErr openDocsEventHandler(AppleEvent *appEvent, AppleEvent *reply, SInt32 handlerRefcon)
{
    AEDescList docList;
    OSERR      osError, ignoreErr;
    SInt32      numberOfItems, index;
    DescType    returnedType;
    FSSpec      fileSpec;
    AEKeyword    keyWord;
    Size        actualSize;
    Boolean      result;

    osError = AEGetParamDesc(appEvent, keyDirectObject, typeAEList, &docList);

    if(osError == noErr)
    {
        osError = doHasGotRequiredParams(appEvent);
        if(osError == noErr)
        {
            osError = AECOUNTITEMS(&docList, &numberOfItems);
            if(osError == noErr)
            {
                for(index=1; index<=numberOfItems; index++)
                {
                    osError = AEGETNTHPTR(&docList, index, typeFSS, &keyWord, &returnedType, &fileSpec,
                                           sizeof(fileSpec), &actualSize);
                    if(osError == noErr)
                    {
                        if(!(result = doOpenFile(&fileSpec, index, numberOfItems)))
                            doErrorAlert(eCannotOpenFile);
                    }
                    else
                        doErrorAlert(eGetDescriptorRecord);
                }
            }
            else
                doErrorAlert(eCountDescripRecords);
        }
        else
            doErrorAlert(eMissedRequiredParam);

        ignoreErr = AEDISPOSEDESC(&docList);
    }
    else
        doErrorAlert(eGetRequiredParam);

    return osError;
}
```

```
// ***** printDocsEventHandler

OSErr printDocsEventHandler(AppleEvent *appEvent, AppleEvent *reply, SInt32 handlerRefcon)
{
    AEDescList docList;
    OSErr      osError, ignoreErr;
    SInt32      numberOfItems, index;
    DescType    returnedType;
    FSSpec      fileSpec;
    AEKeyword    keyWord;
    Size        actualSize;
    Boolean      result;

    osError = AEGGetParamDesc(appEvent, keyDirectObject, typeAEList, &docList);

    if (osError == noErr)
    {
        osError = doHasGotRequiredParams(appEvent);
        if (osError == noErr)
        {
            osError = AECCountItems(&docList, &numberOfItems);
            if (osError == noErr)
            {
                for (index = 1; index <= numberOfItems; index++)
                {
                    osError = AEGGetNthPtr(&docList, index, typeFSS, &keyWord, &returnedType, &fileSpec,
                                             sizeof(fileSpec), &actualSize);
                    if (osError == noErr)
                    {
                        if (!(result = doPrintFile(&fileSpec, index, numberOfItems)))
                            doErrorAlert(eCannotPrintFile);
                    }
                    else
                        doErrorAlert(eGetDescriptorRecord);
                }
            }
            else
                doErrorAlert(eCountDescripRecords);
        }
        else
            doErrorAlert(eMissedRequiredParam);

        ignoreErr = AEDisposeDesc(&docList);
    }
    else
        doErrorAlert(eGetRequiredParam);

    return osError;
}
```

```
// ***** quitAppEventHandler

OSErr quitAppEventHandler(AppleEvent *appEvent, AppleEvent *reply, SInt32 handlerRefcon)
{
    OSErr osError;

    osError = doHasGotRequiredParams(appEvent);

    if(osError == noErr)
        doPrepareToTerminate();

    return osError;
}

// ***** sysFontChangeEventHandler

OSErr sysFontChangeEventHandler(AppleEvent *appEvent, AppleEvent *reply,
                                SInt32 handlerRefcon)
{
    OSErr osError;
    Rect portRect;
    Str255 fontName, theString = "\p Current large system font is: ";

    osError = doHasGotRequiredParams(appEvent);

    if(osError == noErr)
    {
        GetWindowPortBounds(gWindowRef, &portRect);
        EraseRect(&portRect);
        doDrawText("\pReceived an Apple event: LARGE SYSTEM FONT CHANGED.");
        GetThemeFont(kThemeSystemFont, smSystemScript, fontName, NULL, NULL);
        doConcatPStrings(theString, fontName);
        doDrawText(theString);
        // Action as required by application.
    }

    return osError;
}

// ***** smallSysFontChangeEventHandler

OSErr smallSysFontChangeEventHandler(AppleEvent *appEvent, AppleEvent *reply,
                                      SInt32 handlerRefcon)
{
    OSErr osError;
    Rect portRect;
    Str255 fontName, theString = "\p Current small system font is: ";

    osError = doHasGotRequiredParams(appEvent);

    if(osError == noErr)
```

```

    {
        GetWindowPortBounds(gWindowRef,&portRect);
        EraseRect(&portRect);
        doDrawText("\pReceived an Apple event: SMALL SYSTEM FONT CHANGED.");
        GetThemeFont(kThemeSmallSystemFont,smSystemScript,fontName,NULL,NULL);
        doConcatPStrings(theString,fontName);
        doDrawText(theString);
        // Action as required by application.
    }

    return osError;
}

// ***** viewsFontChangeEventHandler

OSErr viewsFontChangeEventHandler(AppleEvent *appEvent,AppleEvent *reply,
                                   SInt32 handlerRefcon)
{
    OSErr osError;
    Rect portRect;
    Str255 fontName, fontSizeString, theString = "\p Current views font is: ";
    SInt16 fontSize;

    osError = doHasGotRequiredParams(appEvent);

    if(osError == noErr)
    {
        GetWindowPortBounds(gWindowRef,&portRect);
        EraseRect(&portRect);
        doDrawText("\pReceived an Apple event: VIEWS FONT CHANGED.");
        GetThemeFont(kThemeViewsFont,smSystemScript,fontName,&fontSize,NULL);
        doConcatPStrings(theString,fontName);
        doConcatPStrings(theString,"\p ");
        NumToString((SInt32) fontSize,fontSizeString);
        doConcatPStrings(theString,fontSizeString);
        doConcatPStrings(theString,"\p point");
        doDrawText(theString);
        // Action as required by application.
    }

    return osError;
}

// ***** showPreferencesEventHandler

OSErr showPreferencesEventHandler(AppleEvent *appEvent,AppleEvent *reply,
                                   SInt32 handlerRefcon)
{
    OSErr osError;
    Rect portRect;

    osError = doHasGotRequiredParams(appEvent);

```



```

if(osError == noErr)
{
    GetWindowPortBounds(gWindowRef,&portRect);
    EraseRect(&portRect);
    doDrawText("\pReceived an Apple event: SHOW PREFERENCES.");
    doDrawText("\p    · I would present a Preferences... dialog now.");
}

return osError;
}

// ***** doHasGotRequiredParams

OSErr doHasGotRequiredParams(AppleEvent *appEvent)
{
    OSErr    osError;
    DescType returnedType;
    Size     actualSize;

    osError = AEGetAttributePtr(appEvent,keyMissedKeywordAttr,typeWildCard,&returnedType,NULL,0,
                                &actualSize);

    if(osError == errAEDescNotFound)
        osError = noErr;
    else if(osError == noErr)
        osError = errAEParamMissed;

    return osError;
}

// ***** doOpenFile

Boolean doOpenFile(FSSpec *fileSpecPtr,SInt32 index,SInt32 numberOfItems)
{
    WindowRef windowRef;

    gApplicationWasOpen = true;

    if(index == 1)
        doDrawText("\pReceived an Apple event: OPEN DOCUMENTS.");

    if(numberOfItems == 1)
    {
        doDrawText("\p    · The file to open is: ");
        DrawString(fileSpecPtr->name);
        doDrawText("\p    · Opening titled window in response.");
    }
    else
    {
        if(index == 1)
        {
            doDrawText("\p    · The files to open are: ");
            DrawString(fileSpecPtr->name);
        }
    }
}

```

```

        else
        {
            DrawString("\p and ");
            DrawString(fileSpecPtr->name);
            doDrawText("\p      · Opening titled windows in response.");
        }
    }

    if(windowRef = doNewWindow())
    {
        SetWTitle(windowRef,fileSpecPtr->name);
        return true;
    }
    else
        return false;
}

// ***** doPrintFile

Boolean doPrintFile(FSSpec *fileSpecPtr,SInt32 index,SInt32 numberOfItems)
{
    WindowRef windowRef;
    UInt32 finalTicks;

    if(index == 1)
        doDrawText("\pReceived an Apple event: PRINT DOCUMENTS");

    if(numberOfItems == 1)
    {
        doDrawText("\p      · The file to print is: ");
        DrawString(fileSpecPtr->name);
        windowRef = doNewWindow();
        SetWTitle(windowRef,fileSpecPtr->name);
        Delay(60,&finalTicks);
        doDrawText("\p      · I would present the Print dialog first and then print");
        doDrawText("\p      the document when the user has made his settings.");
        Delay(60,&finalTicks);
        doDrawText("\p      · Assume that I am now printing the document.");
    }
    else
    {
        if(index == 1)
        {
            doDrawText("\p      · The first file to print is: ");
            DrawString(fileSpecPtr->name);
            doDrawText("\p      I would present the Print dialog for the first file");
            doDrawText("\p      only and use the user's settings to print both files.");
        }
        else
        {
            doDrawText("\p      · The second file to print is: ");
            DrawString(fileSpecPtr->name);
            doDrawText("\p      I am using the Print dialog settings used for the");
            doDrawText("\p      first file.");
        }
    }
}

```

```

    windowRef = doNewWindow();
    SetWTitle(windowRef, fileSpecPtr->name);
    doDrawText("\p      · Assume that I am now printing the document.");
}

if(numberOfItems == index)
{
    if(!gApplicationWasOpen)
    {
        doDrawText("\p      Since the application was not already open, I expect to");
        doDrawText("\p      receive a QUIT APPLICATION event when I have finished.");
    }
    else
    {
        doDrawText("\p      Since the application was already open, I do NOT expect");
        doDrawText("\p      to receive a QUIT APPLICATION event when I have finished.");
    }

    Delay(180, &finalTicks);
    doDrawText("\p      · Finished print job.");
}
else
    Delay(180, &finalTicks);

DisposeWindow(windowRef);
return true;
}

// ***** doPrepareToTerminate

void doPrepareToTerminate(void)
{
    UInt32 finalTicks;

    doDrawText("\pReceived an Apple event: QUIT APPLICATION");

    if(gApplicationWasOpen)
    {
        doDrawText("\p      · I would now ask the user to save any unsaved files before");
        doDrawText("\p      terminating myself in response to the event.");
        doDrawText("\p      · Click the mouse when ready to terminate.");
        while(!Button());
    }
    else
    {
        doDrawText("\p      · Terminating myself in response");
        Delay(240, &finalTicks);
    }

    // If the user did not click the Cancel button in a Save dialog:

    gDone = true;
}

```

```

// ***** doNewWindow

WindowRef doNewWindow(void)
{
    WindowRef windowRef;

    if(!(windowRef = GetNewCWindow(rDocWindow,NULL,(WindowRef) -1)))
        doErrorAlert(eCannotOpenWindow);

    return windowRef;
}

// ***** doMenuChoice

void doMenuChoice(SInt32 menuChoice)
{
    MenuID      menuID;
    MenuItemIndex menuItem;

    menuID      = HiWord(menuChoice);
    menuItem    = LoWord(menuChoice);

    if(menuID == 0)
        return;

    switch(menuID)
    {
        case mFile:
            if(menuItem == iQuit)
                gDone = true;
            break;
    }

    HiliteMenu(0);
}

// ***** doErrorAlert

void doErrorAlert(SInt16 errorType)
{
    Str255 errorString;
    SInt16 itemHit;

    GetIndString(errorString,rErrorStrings,errorType);

    if(errorType < 7)
        StandardAlert(kAlertCautionAlert,errorString,NULL,NULL,&itemHit);
    else
    {
        StandardAlert(kAlertStopAlert,errorString,NULL,NULL,&itemHit);
        ExitToShell();
    }
}

```

```
// ***** doDrawText

void doDrawText(Str255 eventString)
{
    RgnHandle tempRegion;
    SInt16    a;
    Rect      portRect;
    UInt32    finalTicks;

    tempRegion = NewRgn();
    GetWindowPortBounds(gWindowRef,&portRect);

    for(a=0;a<15;a++)
    {
        ScrollRect(&portRect,0,-1,tempRegion);
        QDFlushPortBuffer(GetWindowPort(gWindowRef),NULL);

        Delay(4,&finalTicks);
    }

    DisposeRgn(tempRegion);

    MoveTo(8,160);
    DrawString(eventString);
    QDFlushPortBuffer(GetWindowPort(gWindowRef),NULL);
}

// ***** doConcatPStrings

void doConcatPStrings(Str255 targetString,Str255 appendString)
{
    SInt16 appendLength;

    appendLength = MIN(appendString[0],255 - targetString[0]);

    if(appendLength > 0)
    {
        BlockMoveData(appendString+1,targetString+targetString[0]+1,(SInt32) appendLength);
        targetString[0] += appendLength;
    }
}

// *****
```

## Demonstration Program AppleEvents Comments

The demonstration requires that the user open the windows containing the AppleEvents application icon and the two document file icons AppleEvents Document A and AppleEvents Document B.

Using all of the methods available in the Finder (that is, double clicking the icons, dragging document icons to the application icon, selecting the icons and choosing Open and (on Mac OS 8/9 only) Print from the Finder's File menu, choosing the application from the Apple menu), the user should launch the application, open the simulated documents and (on Mac OS 8/9 only) "print" the documents, noting the descriptive text printed in the non-document window in response to the receipt of the resulting Apple events.

When the application is running, the user should double-click the application icon, choose the application from the Mac OS 8/9 Apple menu, or click the application icon and choose Open from the Finder's File menu, noting the receipt of the Re-open Application event. This should be done when one or more document windows are open and when no document windows are open.

The user should also choose Restart or Shut Down while the application is running, also noting the displayed text resulting from receipt of the Quit Application event. (On Mac OS X, the Quit Application event is also received when Quit is chosen from the Application menu.)

On Mac OS 8/9, opening and printing should be attempted (from the Finder's File menu) when the application is already running and when the application is not running.

On Mac OS X, the user should choose Show Preferences... from the Application menu.

Note that, in this demonstration, it is possible to "open" each document more than once, that is, it is possible to have several "Document A" and/or "Document B" windows open at once. (A real application would permit only one "Document A" and/or one "Document B" window to be open at any one time.) The reason for this is that, in this demonstration, files are not actually opened; accordingly, it is not possible to check whether the relevant file is already open.

With regard to the Appearance Manager Apple events, the user should make changes to the system font, small system font, and views font in the Fonts tab of the Appearance control panel, noting the descriptive text that appears in the non-document window.

Although not related to the required Apple events aspects of the program, the following aspects of the demonstration may also be investigated:

- On Mac OS 8/9, the customized finder icon help override help balloon for the application icon. (The 'hfdrr' resource refers.)
- The version information for the application in the Finder's Get Info (Mac OS 8/9) and Show Info (Mac OS X) window and in the window containing the AppleEvents application when list view is selected.

### **'plst' Resource**

The following is the information property list in the application's 'plst' resource:

```

<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist SYSTEM "file://localhost/System/Library/DTDs/PropertyList.dtd">
<plist version="0.9">
<dict>
  <key>CFBundleInfoDictionaryVersion</key>
  <string>6.0</string>
  <key>CFBundleName</key>
  <string>AppleEvents</string>
  <key>CFBundlePackageType</key>
  <string>APPL</string>
  <key>CFBundleSignature</key>
  <string>KJBB</string>
  <key>CFBundleIconFile</key>
  <string>128</string>
  <key>CFBundleIdentifier</key>
  <string>com.Windmill Software.AppleEvents</string>
  <key>LSPrefersCarbon</key>
  <string>Yes</string>
  <key>CFBundleLongVersionString</key>
  <string>Version 1.0.0 June 2001</string>
  <key>CFBundleShortVersionString</key>
  <string>1.0.0</string>
  <key>CFBundleDevelopmentRegion</key>
  <string>English</string>
  <key>NSAppleScriptEnabled</key>
  <string>No</string>
  <key>CFBundleDocumentTypes</key>
  <array>
    <dict>
      <key>CFBundleTypeIconFile</key>
      <string>129</string>
      <key>CFBundleTypeName</key>
      <string>AppleEvents Document</string>
      <key>CFBundleTypeOSTypes</key>
      <array>
        <string>TEXT</string>
      </array>
      <key>CFBundleTypeRole</key>
      <string>Viewer</string>
    </dict>
  </array>
</dict>
</plist>

```

## Global Variables

`gRunningOnX` will be set to true if the program is running on Mac OS X.

`gApplicationWasOpen` will be used to control the manner of program termination when a Quit Application event is received, depending on whether the event followed a Print Documents event (on Mac OS 8/9) or resulted from the user choosing Restart or Shut Down from the Finder's Special menu.



## **main**

In the menus setting up block, if the program is running on Mac OS X, the Preferences item in the Mac OS X Application menu is enabled.

The call to `doInstallAEHandlers` installs the Apple event handlers.

## **doInstallAEHandlers and doInstallAnAEHandler**

`doInstallAEHandlers`, supported by `doInstallAnAEHandler`, installs the handlers for the required Apple events, the Appearance Manager Apple events, and (if the program is running on Mac OS X) the Show Preferences Apple event in the application's Apple event dispatch table.

In `doInstallAnAEHandler`, `false` is passed in `AEInstallEventHandler's isSysHandler` parameter. `False` causes the handler to be installed in the application's Apple event dispatch table. `True` causes handlers to be installed in the system's Apple event dispatch table. (The system Apple event dispatch table is a table in the system heap containing handlers that are available to all applications and processes running on the same computer.)

## **doEvents**

The `kHighLevelEvent` case accommodates the receipt of a high-level event, in which case `AEProcessAppleEvent` is called. (`AEProcessAppleEvent` looks in the application's Apple event dispatch table for a match to the event class and event ID contained in, respectively, the event structure's message and where fields, and calls the appropriate handler.)

## **doOpenAppEvent**

`doOpenAppEvent` is the handler for the Open Application event.

At the first line, the global variable `gApplicationWasOpen`, which controls the manner of program termination when a Quit Application event is received, is set to `true`. (This line is required for demonstration program purposes only.)

The function `doHasGotRequiredParams` is then called to check whether the Apple event contains any required parameters. If so, the handler returns an error because, by definition, the Open Application event should not contain any required parameters.

If `noErr` is returned by `doHasGotRequiredParams`, the handler does what the user expects the application to do when it is opened, that is, it opens an untitled document window (the call to `doNewWindow` and the subsequent call to `SetWTitle`). The handler then returns `noErr`.

If `errAEParmMissed` is returned by `doHasGotRequiredParams`, this is returned by the handler.

The calls to `doDrawText` simply print some text in the text window for demonstration program purposes.

## doReopenAppEvent

doReopenAppEvent is the handler for the Re-open Documents event.

At the first line, the function `doHasGotRequiredParams` is called to check whether the Apple event contains any required parameters. If so, the handler returns an error because, by definition, the Re-open Application event should not contain any required parameters.

If `noErr` is returned by `doHasGotRequiredParams`, and if there are currently no open windows, the handler opens an untitled document window and returns `noErr`.

If `errAEPParamMissed` is returned by `doHasGotRequiredParams`, this is returned by the handler.

The calls to `doDrawText` simply print some text in the text window for demonstration program purposes.

## doOpenDocsEvent

doOpenDocsEvent is the handler for the Open Documents event.

At the first line, `AEGetParamDesc` is called to get the direct parameter (specified in the `keyDirectObject` keyword) out of the Apple event. The constant `typeAEList` specifies the descriptor type as a list of descriptor structures. The descriptor list is received by the `docList` variable.

Before proceeding further, the handler checks that it has received all the required parameters by calling the function `doHasGotRequiredParams`.

Having retrieved the descriptor list from the Apple event, the handler calls `AECntItems` to count the number of descriptors in the list.

Using the returned number as an index, `AEGetNthPtr` is called to get the data of each descriptor structure in the list. In the `AEGetNthPtr` call, the parameter `typeFSS` specifies the desired type of the resulting data, causing the Apple Event Manager to coerce the data in the descriptor structure to a file system specification structure. Note also that `keyWord` receives the keyword of the specified descriptor structure, `returnedType` receives the descriptor type, `fileSpec` receives a pointer to the file system specification structure, `sizeof(fileSpec)` establishes the length, in bytes, of the data returned, and `actualSize` receives the actual length, in bytes, of the data for the descriptor structure.

After extracting the file system specification structure describing the document to open, the handler calls the function for opening files (`doOpenFile`). (In a real application, that function would typically be the same as that invoked when the user chooses Open from the application's File menu.)

If the call to `AEGetNthPtr` does not return `noErr`, the error handling function (`doErrorAlert`) is called. (`AEGetNthPtr` will return an error code if there was insufficient room in the heap, the

data could not be coerced, the descriptor structure was not found, the descriptor was of the wrong type, or the descriptor structure was not a valid descriptor structure.)

If the call to `doHasGotRequiredParams` does not return `noErr`, the error handling function (`doErrorAlert`) is called. (`doHasGotRequiredParams` returns `noErr` only if you got all the required parameters.)

Since the handler has no further requirement for the data in the descriptor list, `AEDisposeDesc` is called to dispose of the descriptor list.

If the call to `AEGetParamDesc` does not return `noErr` the error handling function (`doErrorAlert`) is called. (`AEGetParamDesc` will return an error code for much the same reasons as will `AEGetNthPtr`.)

### **doPrintDocsEvent**

`doPrintDocsEvent` is the handler for the Print Documents event.

The code is identical to that for the Open Documents event handler `doOpenDocs` except that the function for printing files (`doPrintFile`) is called rather than the function for simply opening files (`doOpenFile`).

### **doQuitAppEvent**

`doQuitAppEvent` is the handler for the Quit Application event.

After checking that it has received all the required parameters by calling the function `doHasGotRequiredParams`, the handler calls the function `doPrepareToTerminate`.

### **doSysFontChangeEvent, doSmallSysFontChange, and doViewsFontChangeEvent**

`doSysFontChangeEvent`, `doSmallSysFontChange`, and `doViewsFontChangeEvent` are the handlers for the appearance Apple events.

The function `doHasGotRequiredParams` is called to check whether the Apple event contains any required parameters. If so, the handler returns an error because, by definition, these events should not contain any required parameters.

The handlers then draw some advisory text in the non-document window indicating that the event has been received, call the Appearance Manager function `GetThemeFont` to obtain information about the relevant font (large system, small system, or views), and draw the font name (and, in the case of the views font, the font size).

### **showPreferencesEventHandler**

`showPreferencesEventHandler` is the handler for the Show Preferences Apple event. It simply draws some advisory text in the window to prove that the event was received.

### doHasGotRequiredParams

`doHasGotRequiredParams` is the function called by `doOpenAppEvent`, `doReopenAppEvent`, `doSysFontChangeEvent`, `doSmallSysFontChange`, and `doViewsFontChangeEvent` to confirm that the event passed to it contains no required parameters, and by the other required Apple event handlers to check that they have received all the required parameters.

The first parameter in the call to `AEGetAttributePtr` is a pointer to the Apple event in question. The second parameter is the Apple event keyword; in this case the constant `keyMissedKeywordAttr` is specified, meaning the first required parameter remaining in the event. The third parameter specifies the descriptor type; in this case the constant `typeWildcard` is specified, meaning any descriptor type. The fourth parameter receives the descriptor type of the returned data. The fifth parameter is a pointer to the data buffer, which stores the returned data. The sixth parameter is the maximum length of the data buffer to be returned. Since we do not need the data itself, these parameters are set to `NULL` and `0` respectively. The last parameter receives the actual length, in bytes, of the data buffer for the attribute.

`AEGetAttributePtr` returns the result code `errAEDescNotFound` if the specified descriptor type (`typeWildcard`, that is, any descriptor type) is not found, meaning that the handler extracted all the required parameters. In this event, `doHasGotRequiredParams` returns `noErr`.

If `AEGetAttributePtr` returns `noErr`, the handler has not extracted all of the required parameters, in which case, the handler should return `errAEParmMissed` and not handle the event. Accordingly, `errAEParmMissed` is returned to the handler (and, in turn, by the handler) if `noErr` is returned by `AEGetAttributePtr`.

### doOpenFile

`doOpenFile` takes the file system specification structure and opens a window with the filename contained in that structure repeated in the window's title bar (the calls to `doNewWindow` and `SetWindowTitle`). The rest of the `doOpenFile` code simply draws explanatory text in the text window.

In a real application, this is the function that would open files as a result of, firstly, the receipt of the Open Documents event and, secondly, the user choosing Open from the application's File menu and then choosing a file or files from the resulting Navigation Services Open dialog.

### doPrintFile

`doPrintFile` is applicable to Mac OS 8/9 only. It is the function which, in a real application, would take the file system specification structure passed to it from the Print Documents event handler, extract the filename and control the printing of that file. In this demonstration, most of the `doPrintFile` code is related to drawing explanatory text in the text window.

If your application can interact with the user, it should open windows for the documents, display a Print dialog for the first document, and use the settings entered by the user for the first document to print all documents.

Note that if your application was not running when the user selected a document icon and chose Print from the Finder's File menu, the Finder will send a Quit Application event following the print operation.

### **doPrepareToTerminate**

`doPrepareToTerminate` is the function called by the Quit Application event handler. In this demonstration, `gDone` will be set to true, and the program will thus terminate immediately, if the Quit Application event resulted from the user initiating a print operation from the Mac OS 8/9 Finder when the application was not running.

If the application was running (`gApplicationWasOpen` contains true) and the Quit Application event thus arose from the user selecting Restart or Shut Down from the Finder's File menu, the demonstration waits for a button click before setting `gDone` to true. (In a real application, and where appropriate, this area of the code would invoke alerts to ascertain whether the user wished to save changed documents before closing down.)

Note that, when your application is ready to quit, it must call `ExitToShell` from the main event loop, not from the handlers for the Quit Application event. Your application should quit only after the handler returns `noErr` as its function result.

### **doNewWindow**

`doNewWindow` opens document windows in response to calls from the Open Application and Open Documents event handlers.



## IN THIS CHAPTER

- QuickDraw and Imaging 496
- RGB Colors and Pixels 496
- Color and the Video Device 496
- Graphics Port 499
- Translation of RGB Colors to Pixel Values 506
- Graphics Devices and GDevice Structures 509
- Other Graphics Managers 511
- Coping with Multiple Monitors 512
- Relevant QuickDraw Constants, Data Types, and Functions 512
- Demonstration Program PreQuickDraw Listing 516
- Demonstration Program PreQuickDraw Comments 527

## QuickDraw and Imaging

**QuickDraw** is a collection of system software routines that your application uses to perform **imaging** operations, that is, the construction and display of graphical information for display on output devices such as screens and printers.

This chapter serves as a prelude to Chapter 12, and introduces certain matters that need to be discussed before the matter of actually drawing with QuickDraw is addressed. These matters include RGB colors, color and the video device, the graphics port, translation of RGB values, and graphics devices.

## RGB Colors and Pixels

In QuickDraw, colors are specified as **RGB colors** using an `RGBColor` structure:

```
struct RGBColor
{
    unsigned short red;    // Magnitude of red component.
    unsigned short green;  // Magnitude of green component.
    unsigned short blue;   // Magnitude of blue component.
};
typedef struct RGBColor RGBColor;
```

Note that an RGB color is defined by three components (red, green and blue). When the red, green and blue fields of the `RGBColor` structure are assigned the maximum possible value (`0xFFFF`), the resulting color is white. When these fields are assigned the minimum value (`0x0000`), the resulting color is black.

A **pixel** (picture element) is the smallest dot that QuickDraw can draw. Each color pixel represents up to 48 bits in memory.

## Color and the Video Device

QuickDraw supports a variety of screens of differing sizes and color capabilities, and is thus device-independent. Accordingly, you do not have to concern yourself with the capabilities of individual screens. For example, when your application uses an `RGBColor` structure to specify a color by its red, green and blue components, with each component defined in a 16-bit integer, QuickDraw compares the resulting 48-bit value with the colors actually available on a video device (such as a plug-in video card or a built-in video interface) at execution time and then chooses the closest match. What the user finally sees depends on the characteristics of the actual video device and screen.



The video device that controls a screen may have either:

- **Indexed colors**, which support pixels of 1-bit, 2-bit, 4-bit, or 8-bit pixel depths. The indexed color system was introduced with the Macintosh II, that is, at a time when memory was scarce and moving megabyte images around was quite impractical.
- **Direct colors**, which support pixels of 16-bit and 32-bit depths. Most video devices in the current day are direct color devices. (However, as will be seen, there are circumstances in which a direct color device will act like an indexed color device.)

#### NOTE

Pixel depth means the number of bits assigned to each pixel, and thus determines the maximum number of colors that can be displayed at the one time. A 4-bit pixel depth, for example, means that an individual pixel can be displayed in any one of 16 separate colors. An 8-bit pixel depth means that an individual pixel can be displayed in any one of 256 separate colors.

QuickDraw automatically determines which method is used by the video device and matches your requested 48-bit color with the closest available color.

## Indexed Color Devices

Video devices using indexed colors support a maximum of 256 colors at any one time, that is, with indexed color, the maximum value of a pixel is limited to a single byte, with each pixel's byte specifying one of 256 different values.

Video devices implementing indexed color contain a data structure called a **color lookup table (CLUT)**, which contains entries for all possible color values. Most indexed video devices use a **variable CLUT**, which allows your application to load the CLUT with different sets of colors depending on the image being displayed.

When your application uses a 48-bit `RGBColor` structure to specify a color, the Color Manager compares the CLUT entries on the video device with the specified `RGBColor` color, determines which color in the CLUT is closest, and passes QuickDraw the index to this color. This is the color that QuickDraw draws with. Fig 1 illustrates this process.

## Direct Color Devices

Video devices which implement direct color eliminate the competition for limited color lookup table spaces and remove the need for color table matching. By using direct color, video devices can support thousands or millions of colors.

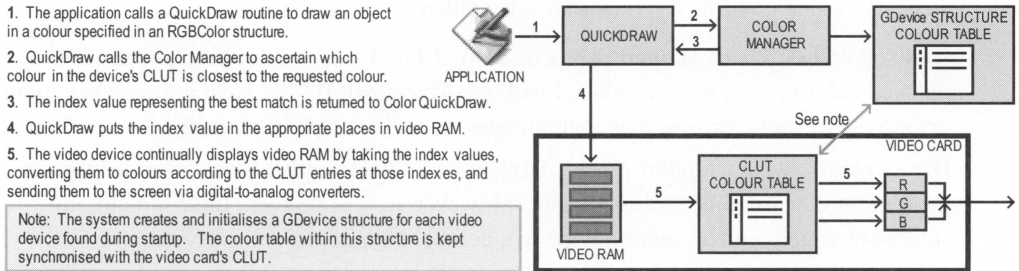


FIG 1 - INDEXED COLOUR SYSTEM

When you specify a color using a 48-bit RGBColor structure on a direct color system, QuickDraw truncates the least significant bits of its red, green and blue components to either 16 bits (five bits each for red, green and blue, with one bit unused) or 32 bits (eight bits for red, green and blue, with eight bits unused). (See “Translation of RGB Colors to Pixel Values.”) Using 16 bits, direct video devices can display 32,768 different colors. Using 32 bits, the device can display 16,777,215 different colors

Fig 2 illustrates the direct color system.

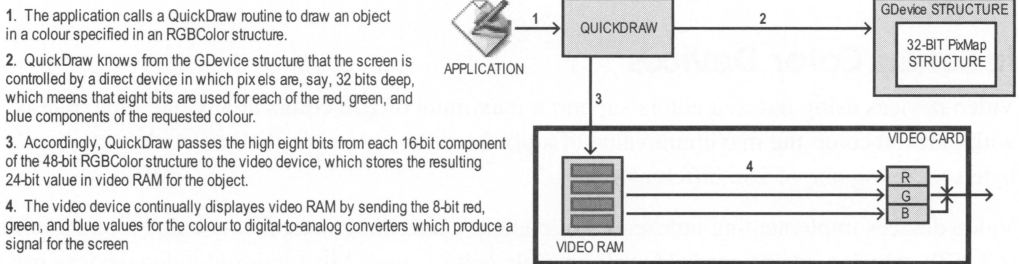


FIG 2 - DIRECT COLOUR SYSTEM

Direct color not only removes much of the complexity of the CLUT mechanism for video device developers, but also allows the display of thousands or millions of colors simultaneously, resulting in near-photographic resolution.

## Direct Devices Operating Like Indexed Devices

Note that, when a user sets a direct color device to use 256 colors (or less) as either a grayscale or color device, the direct device creates a CLUT and operates like an indexed device.

## Graphics Port

A graphics port defines a complete drawing environment. Among other things, a graphics port

- Contains a handle to a **pixel map** that, in turn, contains a pointer to the area of memory in which your drawing operations take place.
- Contains a metaphorical graphics **pen** with which to perform drawing operations. (You can set this pen to different sizes, patterns and colors.)
- Holds information about text, which is styled and sized according to information in the graphics port.

### NOTE

The term “graphics port” originally pertained to the one-bit graphics port used by the early black-and-white Macintoshes. The color graphics port was introduced when color came to the Macintosh with the Macintosh II. In the Carbon era, the black-and-white graphics port is irrelevant. Accordingly, where the term “graphics port” is used in this book, a color graphics port should be assumed unless otherwise stated.

The information in a graphics port is maintained by QuickDraw.

The graphics port is an opaque data structure. The data types `CGrafPtr` and `GrafPtr` are defined as pointers to such objects:

```
typedef struct OpaqueGrafPtr* GrafPtr;  
typedef GrafPtr CGrafPtr;
```

## Accessor Functions

Accessor functions are provided to access the information in color graphic port objects. The main accessor functions are as follows:

<i>Accessor Function</i>	<i>Description</i>
<code>GetPortPixMap</code>	Get a handle to the graphics port's pixel map
<code>GetPortBounds</code>	Get and set the graphics port rectangle.
<code>SetPortBounds</code>	Your application's drawing operations take place inside the port rectangle (which, for a window's graphics port is also called the <b>content region</b> ).  The port rectangle uses a local coordinate system in which the upper-left corner of the port rectangle has a vertical coordinate of 0 and a horizontal coordinate of 0.

<i>Accessor Function</i>	<i>Description</i>
GetPortVisRegion SetPortVisRegion	Get and set the visible region. The <b>visible region</b> (which, by default, is equivalent to the port rectangle) is the region of the graphics port that is actually visible on screen (see Fig 3).
GetPortClipRegion SetPortClipRegion SetClip	Get and set the clipping region. The <b>clipping region</b> is an arbitrary region used to limit drawing to any region within the port rectangle. The default clipping region is set arbitrarily large; however, your application can change this. In Fig 3, for example, SetPortClipRegion (or ClipRect) has been used to change Window B's clipping region so as to prevent the scroll bar areas being overdrawn.

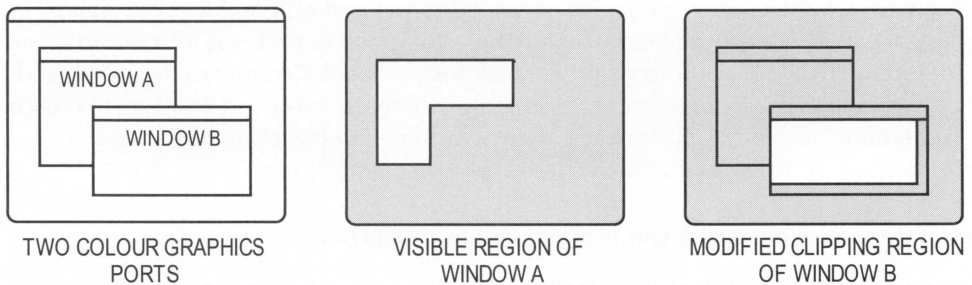


FIG 3 - VISIBLE REGION AND CLIPPING REGION

GetPortForeColor RGBForeColor	Get and set the foreground color. These functions get and set an RGBColor structure that contains the <i>requested foreground color</i> . By default, the foreground color is black.
GetPortBackColor RGBBackColor	Get and set the background color. These functions get and set an RGBColor structure that contains the <i>requested background color</i> . By default, the background color is white.
GetPortBackPixPat SetPortBackPixPat BackPixPat BackPat	Get and set the background pixel pattern. These functions get and set a handle to a PixPat structure that describes the background <b>pixel pattern</b> . Various QuickDraw functions use this pattern for filling scrolled or erased areas.
GetPortPenPixPat SetPortPenPixPat PenPixPat PenPat	Get and set the pen pixel pattern. These functions get and set a handle to a PixPat structure that describes the pixel pattern used by the graphics pen for drawing lines and framed shapes, and for painting shapes.

<i>Accessor Function</i>	<i>Description</i>
GetPortFillPixPat	Get the fill pixel pattern. This function gets a handle to a PixPat structure that describes the pixel pattern used when you call QuickDraw shape filling functions.
GetPortPenLocation MoveTo	Get and set the pen location. The pen location is the point where QuickDraw will begin drawing the next line, shape, or character. It can be anywhere on the coordinate plane.
GetPortPenSize SetPortPenSize PenSize	Get and set the pen size. Pen size is the vertical height and horizontal width of the graphics pen. The default size is a 1-by-1 pixel square. If either the pen width or height is 0, the pen does not draw.
GetPortPenMode SetPortPenMode PenMode	Gets and sets the pen transfer mode. The pen <b>transfer mode</b> is a Boolean or arithmetic operation that determines how QuickDraw transfers the pen pattern to the pixel map during drawing operations. (See Chapter 12.)
HidePen/ShowPen GetPortPenVisibility	Gets and sets pen visibility. The pen's <b>visibility</b> means whether it draws on the screen.
GetPortTextFont TextFont	Get and set the font number for text. These functions get and set a <b>font family ID</b> , that is, a number that identifies the font to be used in the graphics port.
GetPortTextSize TextSize	Get and set the text size. The text size is expressed in pixels, and is used by the Font Manager to provide the bitmaps for text drawing.
GetPortTextFace TextFace	Get and set the text style. The <b>style</b> of the text means, for example, bold, italic, and/or underlined.
GetPortTextMode TextMode	Get and set the text mode. The text mode is the transfer mode for text drawing, which functions much like the transfer mode specified in the pnMode field.
HiliteColor	Get the highlight color. (The highlight color is copied to the graphics port from the low memory global HiliteRGB.)

You can open many graphics ports at the same time. Each has its own local coordinate system, drawing pattern, background pattern, pen size and location, foreground color, background color, pixel map, and so on. You can instantly switch from one graphics port to another using the functions SetPort, SetPortDialogPort, and SetPortWindowPort.



When you use Window Manager and Dialog Manager functions to create windows, dialogs, and alerts, those managers automatically create graphics ports for you.

## Pixel Maps

QuickDraw draws in a **pixel map**. The graphics port object contains a handle to a pixel map, which is a data structure of type `PixMap`. A `PixMap` structure contains a pointer to a **pixel image**, as well as information on the image's storage format, depth, resolution, and color usage. The `PixMap` structure is as follows:

```
struct PixMap
{
    Ptr        baseAddr;    // Pointer to image data.
    short      rowBytes;    // Flags, and bytes in a row.
    Rect       bounds;      // Boundary rectangle.
    short      pmVersion;   // Pixel Map version number.
    short      packType;    // Packing format.
    long       packSize;    // Size of data in packed state.
    Fixed      hRes;        // Horizontal resolution in dots per inch.
    Fixed      vRes;        // Vertical resolution in dots per inch.
    short      pixelType;   // Format of pixel image.
    short      pixelSize;   // Physical bits per pixel.
    short      cmpCount;    // Number of components in each pixel.
    short      cmpSize;     // Number of bits in each component.
    long       planeBytes;  // Offset to next plane.
    CTabHandle pmTable;     // Handle to a color table for this image.
    long       pmReserved;  // (Reserved.)
};
typedef struct PixMap PixMap,*PixMapPtr,**PixMapHandle;
```

### Field Descriptions

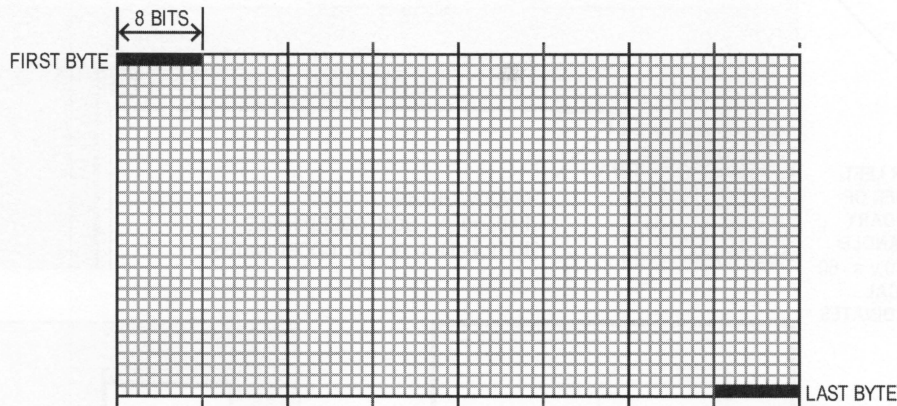
**baseAddr** In the case of an onscreen pixel image, a pointer to the first byte of the image data. Note that there can be several pixel maps pointing to the same pixel image, each imposing its own coordinate system on it.

A pixel image is analogous to the **bit image**. A bit image is a collection of bits in memory that form a grid. Fig 4 illustrates a bit image, which can be visualized as a matrix of rows and columns of bits with each row containing the same number of bytes. Each bit corresponds to one screen pixel. If a bit's value is 0, its screen pixel is white; if the bit's value is 1, the screen pixel is black. A pixel image is essentially the same as a bit image, except that a number of bits, not just one bit, are assigned to each pixel. The number of bits per pixel in a pixel image is called the pixel depth.

**rowBytes** The offset in bytes from one row of the image to the next.

**bounds** On Mac OS 8/9, the boundary rectangle defines the area of the pixel image into which QuickDraw can draw and provides the link between the local coordinate system of a graphics

port and QuickDraw's global coordinate system. All drawing in a graphics port occurs in the intersection of the boundary rectangle and the port rectangle (and, within that intersection, all drawing is cropped to the graphics port's visible region and its clipping region).



**FIG 4 - A BIT IMAGE**

As shown in Fig 5, on Mac OS 8/9, QuickDraw assigns the entire screen as the boundary rectangle. The boundary rectangle shares the same local coordinate system as the port rectangle of the window.

You should not, incidentally, use the `bounds` field to determine the size of the screen; instead, use the `gdRect` field of the `GDevice` structure.

On Mac OS X, the `bounds` field contains the bounds of the Core Graphics window that backs the Carbon window, and different mechanisms are employed to determine where the window's pixel map should be drawn.

**pmVersion** The QuickDraw version number that created this `PixMap` structure.

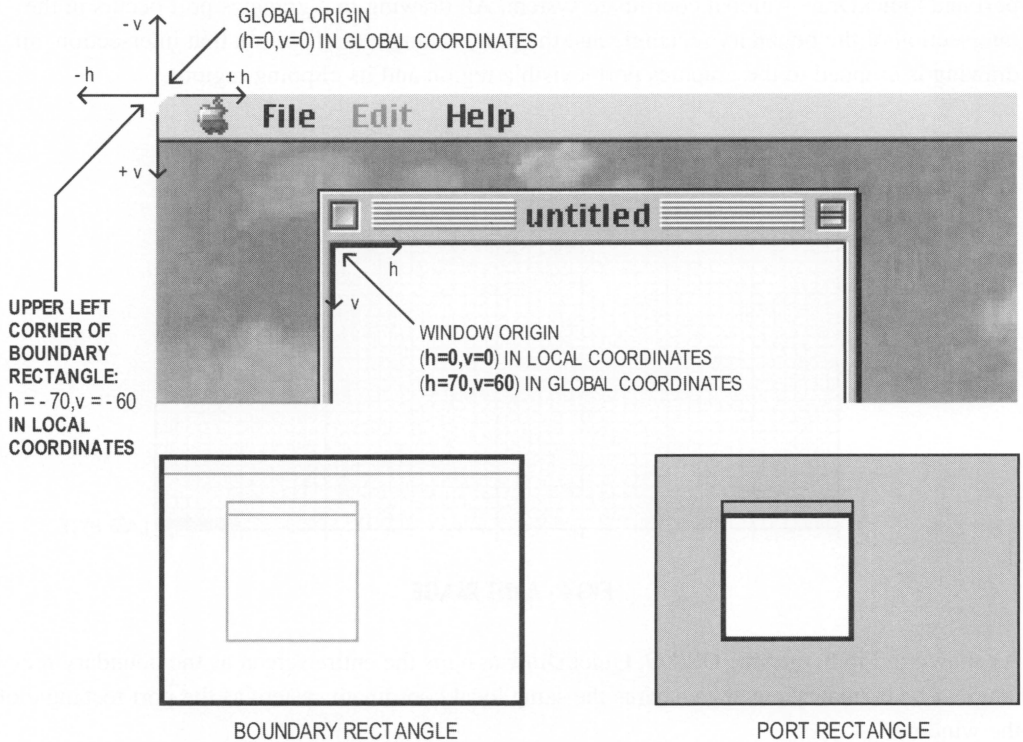
**packType** The packing algorithm used to compress the image data.

**packSize** The size of the packed image.

**hRes** The horizontal resolution of the pixel image in pixels per inch, abbreviated as dpi (dots per inch). By default, the value here is 0x00480000 (for 72 dpi), but QuickDraw supports `PixMap` structures of other resolutions. For example, `PixMap` structures for scanners can have dpi resolutions of 150, 200, 300, or greater.

**vRes** The vertical resolution. (See `hRes`.)





**FIG 5 - LOCAL AND GLOBAL COORDINATE SYSTEMS, THE BOUNDARY RECTANGLE AND THE PORT RECTANGLE - MAC OS 8/9**

**pixelType** The storage format. 0 indicates indexed pixels. 16 (RGBDirect) indicates direct pixels.

**pixelSize** The number of bits used to represent a pixel.

**cmpCount** The number of components used to represent a color for a pixel. For indexed pixels, this field contains 1. For direct pixels this field contains the value 3.

**cmpSize** The size of each color component. For indexed devices, this is the same value as that in the **pixelSize** field. For direct devices, each of the three color components can be either 5 bits for a 16-bit pixel (one of these 16 bits is unused), or 8 bits for a 32-bit pixel (8 of these 32 bits are unused). (See "Translation of RGB Colors to Pixel Values.")

**planeBytes** Multiple-plane images are not supported, so the value of this field is always 0.

**pmTable** A handle to the **ColorTable** structure. **ColorTable** structures define the colors available for pixel images on indexed devices. Pixel images on direct devices do not need a color table because the colors are stored right in the pixel values. In the case of direct devices, **pmTable** points to a dummy color table.

## Functions

Carbon introduced the following functions relating to pixel maps:

<i>Function</i>	<i>Description</i>
GetPixBounds	Get the pixel map's boundary rectangle
GetPixDepth	Gets the pixel map's pixel depth

## Pixel Patterns

The graphics port object stores handles to pixel patterns, structures of type `PixPat`.

Pixel patterns, which define a repeating design, can use colors at any pixel depth, and can be of any width and height that is a power of 2. You can create your own pixel patterns in your program code, but it is usually more convenient to store them in resources of type 'ppat'. Fig 6 shows an 8-by-8 pixel 'ppat' resource being created using Resorcerer.

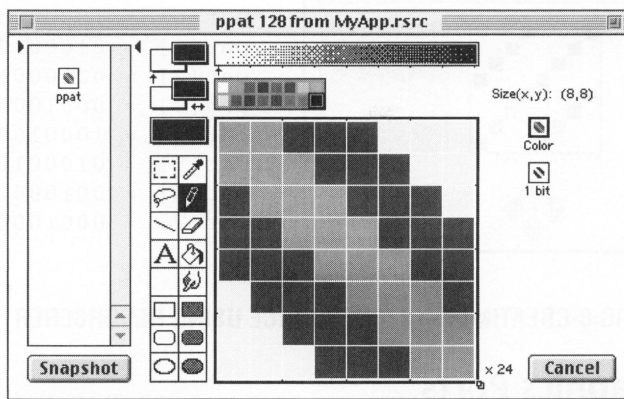


FIG 6 - CREATING A 'ppat' RESOURCE USING RESORCERER

## Bit Patterns

Bit patterns date from the era of the black-and-white Macintosh, but may be stored in a color graphics port object. (`PixPat` structures can contain bit patterns as well as pixel patterns.) Bit patterns are defined in data structures of type `Pattern`, a 64-pixel image of a repeating design organized as an 8-by-8 pixel square.

Five bit patterns are predefined as QuickDraw global variables. The five predefined patterns are available not only through the QuickDraw globals but also as system resources. Fig 7 shows images drawn using some of the 38 available system-supplied bit patterns.

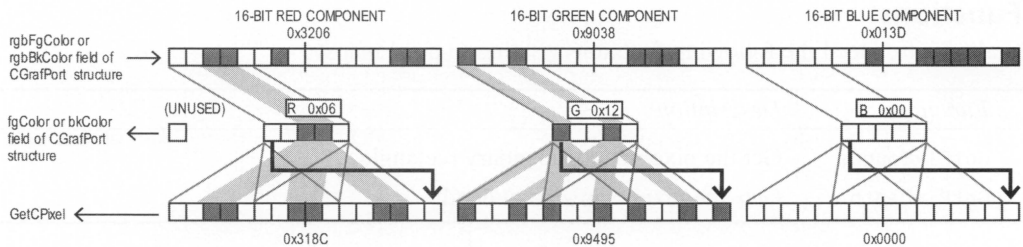


FIG 11 - TRANSLATING AN RGBColor STRUCTURE TO A 16 BIT PIXEL VALUE, AND FROM A 16-BIT PIXEL VALUE TO AN RGBColor STRUCTURE, ON A DIRECT DEVICE

You can create your own bit patterns in your program code, but it is usually more convenient to store them in resources of type 'PAT' or 'PAT#'. Fig 8 shows a 'PAT' resource being created using Resorcerer, together with the contents of the pat field of the structure of type Pattern that is created when the resource is loaded.

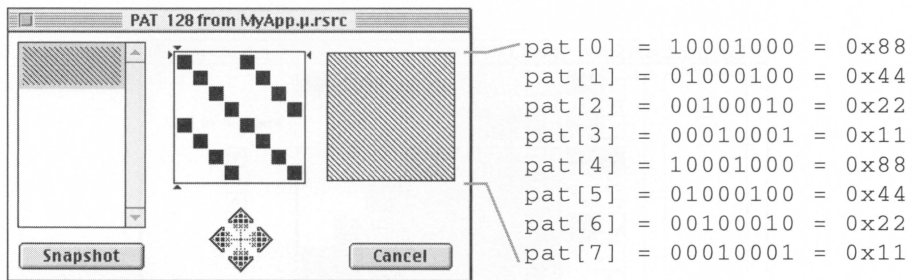


FIG 8-CREATING A 'PAT' RESOURCE USING RESORCERER

## Creating Graphics Ports

Your application creates a (color) graphics port using either the `GetNewCWindow`, `NewCWindow`, or `NewGWorld` function. These functions automatically call `CreateNewPort`, which opens the port.

## Translation of RGB Colors to Pixel Values

As previously stated, the graphics port object contains a pointer to the beginning of the onscreen pixel image. When your application specifies an RGB color for a pixel in the pixel image, QuickDraw translates that color into a value appropriate for display on the user's screen. QuickDraw stores this value in the pixel. The **pixel value** is a number used by system software and a graphics device to represent a color. The translation from the color you specify

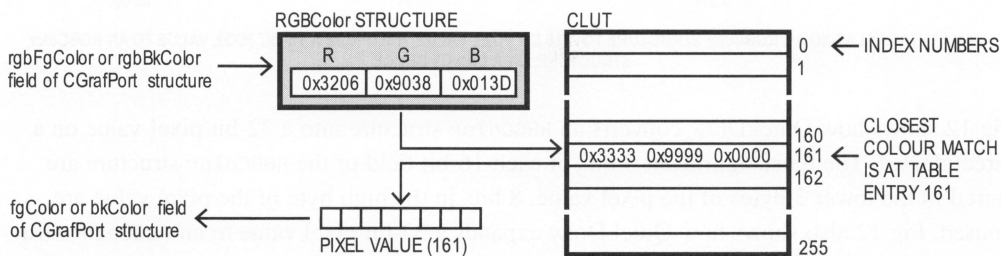
in an `RGBColor` structure to a pixel value is performed at the time you draw the color. The process differs for direct and indexed devices as follows:

- When drawing on indexed devices, QuickDraw calls the Color Manager to supply the index to the color that most closely matches the requested color in the current device's CLUT. This index becomes the pixel value for that color.
- When drawing on direct devices, QuickDraw truncates the least significant bits from the red, green and blue fields of the `RGBColor` structure. The result becomes the pixel value that QuickDraw sends to the graphics device.

Your application never needs to handle pixel values. However, to clarify the relationship between `RGBColor` structures and the pixels that are actually displayed, the following presents some examples of the derivation of pixel values from `RGBColor` structures.

## Derivation of Pixel Values on Indexed Devices

Fig 9 shows the translation of an `RGBColor` structure to an 8-bit pixel value on an indexed device.

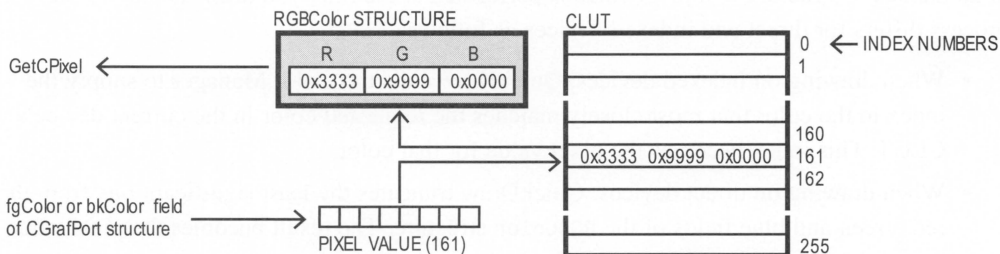


**FIG 9 - TRANSLATING AN `RGBColor` STRUCTURE TO AN 8-BIT PIXEL VALUE ON AN INDEXED DEVICE**

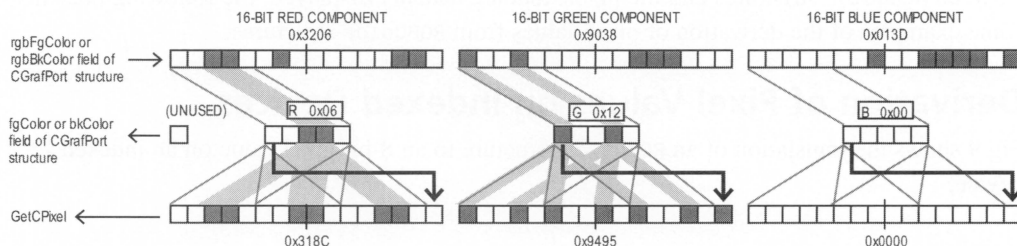
An application might call `GetCPixel` to determine the color of a pixel set by the pixel value in Fig 9. As shown in Fig 10, the Color Manager uses the pixel value (an index number) to find the `RGBColor` structure stored in the CLUT for that pixel's color. This is the color returned by `GetCPixel`. As shown in Fig 10, this is not necessarily the exact color first specified.

## Derivation of Pixel Values on Direct Devices

Fig 11 shows how QuickDraw converts an `RGBColor` structure into a 16-bit pixel value on a direct device. The most significant 5 bits of each field of the `RGBColor` structure are stored in the lower 15 bits of the pixel value. The high bit is unused. Fig 11 also shows how QuickDraw expands a 16-bit pixel value to a 48-bit `RGBColor` structure. Each 5-bit component, and the most significant bit, are inserted into each 16-bit field of the `RGBColor` structure. Note the difference between the result and the original 48-bit value.

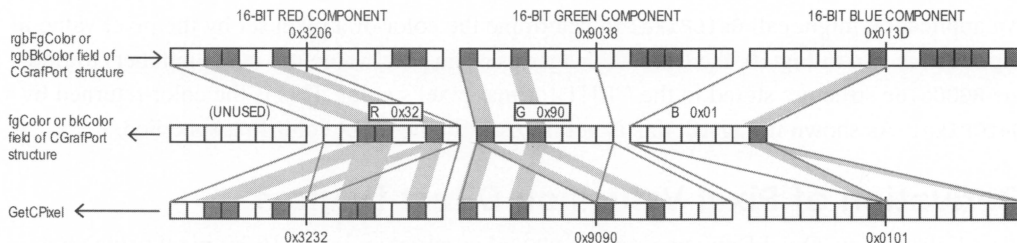


**FIG 10 - TRANSLATING AN 8-BIT PIXEL VALUE ON AN INDEXED DEVICE TO AN RGBColor STRUCTURE**



**FIG 11 - TRANSLATING AN RGBColor STRUCTURE TO A 16 BIT PIXEL VALUE, AND FROM A 16-BIT PIXEL VALUE TO AN RGBColor STRUCTURE, ON A DIRECT DEVICE**

Fig 12 shows how QuickDraw converts an RGBColor structure into a 32-bit pixel value on a direct device. The most significant 8 bits of each 16-bit field of the RGBColor structure are stored in the lower 3 bytes of the pixel value. 8 bits in the high byte of the pixel value are unused. Fig 12 also shows how QuickDraw expands a 32-bit pixel value to an RGBColor structure. Each of the 8-bit components is doubled. Note the difference between the result and the original 48-bit value.



**FIG 12 - TRANSLATING AN RGBColor STRUCTURE TO A 32 BIT PIXEL VALUE, AND FROM A 32-BIT PIXEL VALUE TO AN RGBColor STRUCTURE, ON A DIRECT DEVICE**



## Colors on Grayscale Screens

When QuickDraw displays a color on a grayscale screen, it computes the luminance, or intensity of light, of the desired color and uses that value to determine the appropriate gray value to draw.

A grayscale device can be a graphics device that the user sets to grayscale. For such a graphics device, Color QuickDraw places an evenly spaced set of grays in the graphics device's CLUT.

## Graphics Devices and GDevice Structures

As previously stated, QuickDraw provides a device-independent interface. Your application can draw images in the graphics port for a window and QuickDraw automatically manages the path to the screen—even if the user is using multiple screens. QuickDraw communicates with a video device, such as a plug-in video card or a built-in video interface, by automatically creating and managing a structure of type `GDevice`.

### Types of Graphics Device

A **graphics device** is anything QuickDraw can draw into. There are three types of graphics device:

- **Video devices**, which control screens.
- **Offscreen graphics worlds**. (See Chapter 13.)
- **Printing graphics ports**. (See Chapter 15.)

In the case of a video device for an offscreen graphics world, QuickDraw automatically creates, and stores state information in, a `GDevice` structure.

### GDevice Structure

QuickDraw creates and initializes a `GDevice` structure for each video device found during startup. QuickDraw also automatically creates a `GDevice` structure when you call `NewGWorld` to create an offscreen graphics world.

A list called a **device list** links together all existing `GDevice` structures. The **current device**, which is sometimes called the **active device**, is that device in the device list into which drawing is currently taking place.

Your application generally never needs to create `GDevice` structures; however, it may need to examine `GDevice` structures to determine the capabilities of the user's screens. The `GDevice` structure is as follows:

```

struct GDevice
{
    short      gdRefNum;      // Reference Number of Driver.
    short      gdID;          // Client ID for search procedures.
    short      gdType;        // Type of device (indexed or direct).
    ITabHandle gdITable;      // Handle to inverse lookup table for Color Manager.
    short      gdResPref;     // Preferred resolution.
    SProcHndl  gdSearchProc;  // Handle to list of search functions.
    CProcHndl  gdCompProc;    // Handle to list of complement functions.
    short      gdFlags;       // Graphics device flags.
    PixMapHandle gdPMap;      // Handle to pixel map for displayed image.
    long       gdRefCon;      // Reference value.
    Handle     gdNextGD;      // Handle to next GDevice structure.
    Rect       gdRect;        // Device's global boundaries.
    long       gdMode;        // Device's current mode.
    short      gdCCBytes;     // Width of expanded cursor data.
    short      gdCCDepth;     // Depth of expanded cursor data.
    Handle     gdCCXData;     // Handle to cursor's expanded data.
    Handle     gdCCXMask;     // Handle to cursor's expanded mask.
    long       gdReserved;    // (Reserved. Must be 0.)
};
typedef struct GDevice GDevice;
typedef GDevice *GDPtr, **GDHandle;

```

### Main Field Descriptions

**gdType** The type of graphics device. The flag bits of this field are as follows:

<i>Constant</i>	<i>Bit</i>	<i>Meaning If Set</i>
clutType	0	CLUT device
fixedType	1	Fixed CLUT device
directType	2	Direct device

**gdITable** Points to an **inverse table**. This is a special Color Manager data structure that allows index numbers in a CLUT to be found very quickly.

**gdFlags** Device attributes (that is, whether the device is a screen, whether it is the main screen, whether it is set to black-and-white or color, whether it is the active device, and so on.). The main flag bits in this field are as follows:

<i>Constant</i>	<i>Bit</i>	<i>Meaning If Set</i>
gdDevType	0	Device is a color device. (If not set, device is a black-and-white device.)
mainScreen	11	Device is the main screen.
screenDevice	13	Device is a screen device.
screenActive	15	Device is current device.



**gdPMap** A handle to the pixel map (PixMap) structure.

**gdNextGD** A handle to the next device in the device list. Contains 0 if this is the last graphics device in the device list.

**gdRect** The boundary rectangle of this graphics device. The upper-left corner of the boundary rectangle for the main screen is set to (0,0) and all other graphics devices are relative to this.

## Setting a Device's Pixel Depth

The **gdPMap** field of the **GDevice** structure contains a handle to a **PixMap** structure which, in turn, contains the **PixelSize** field to which is assigned the pixel depth of the device.

The user can change the pixel depth of video devices. Accordingly, although your application may have a preferred pixel depth, it should be flexible enough to accommodate other pixel depths.

Your application can change the pixel depth using **SetDepth**. However, before calling this function, you should call the **HasDepth** function to confirm that the hardware can support the desired pixel depth. Generally speaking, you should not change pixel depth without first seeking the consent of the user via an alert or dialog.

## Other Graphics Managers

In addition to the QuickDraw functions, several other collections of system software functions are available to assist you in drawing images.

### Palette Manager

Your application can use the Palette Manager to provide more sophisticated color support on indexed graphics devices. The Palette Manager allows your application to specify sets of colors that it needs on a window-by-window basis.

### Color Picker Utilities

To solicit color choices from users, your application can use the Color Picker Utilities. The Color Picker Utilities also provide functions that allow your application to convert between colors specified in **RGBColor** structures and colors specified for other color models, such as the CMYK (cyan, magenta, yellow, black) model used for many color printers (see Chapter 25).

## Coping with Multiple Monitors

Aspects of coping with a multiple monitors environment are addressed in Chapter 25.

## Relevant QuickDraw Constants, Data Types, and Functions

### Constants

#### Flag Bits of gdType Field of GDevice Structure

```
clutType    = 0
fixedType   = 1
directType  = 2
```

#### Flag Bits of gdFlags Field of GDevice Structure

```
gdDevType   = 0
burstDevice = 7
ext32Device = 8
ramInit     = 10
mainScreen  = 11
allInit     = 12
screenDevice = 13
noDriver    = 14
screenActive = 15
```

### Pixel Type

RGBDirect = 16 16 and 32 bits-per-pixel pixelType value.

## Data Types

```
typedef struct OpaqueGrafPtr* GrafPtr;
typedef GrafPtr CGrafPtr;
```

### Pixel Map

```
struct PixMap
{
    Ptr          baseAddr;    // Pointer to image data.
    short        rowBytes;    // Flags, and bytes in a row.
    Rect         bounds;      // Boundary rectangle.
    short        pmVersion;   // Pixel Map version number.
    short        packType;    // Packing format.
    long         packSize;    // Size of data in packed state.
    Fixed        hRes;        // Horizontal resolution in dots per inch.
    Fixed        vRes;        // Vertical resolution in dots per inch.
    short        pixelType;   // Format of pixel image.
    short        pixelSize;   // Physical bits per pixel.
    short        cmpCount;    // Number of components in each pixel.
```

```

short      cmpSize;      // Number of bits in each component.
long       planeBytes;   // Offset to next plane.
CTabHandle pmTable;      // Handle to a color table for this image.
long       pmReserved;   // (Reserved.)
};
typedef struct PixMap PixMap,*PixMapPtr,**PixMapHandle;

```

## BitMap

```

struct BitMap
{
    Ptr      baseAddr;    // Pointer to bit image.
    short    rowBytes;    // Row width.
    Rect     bounds;      // Boundary rectangle.
};
typedef struct BitMap BitMap;
typedef BitMap *BitMapPtr, **BitMapHandle;

```

## Pixel Pattern

```

struct PixPat
{
    short    patType;     // Type of pattern.
    PixMapHandle patMap;  // The pattern's pixel map.
    Handle   patData;     // Pixel map's data.
    Handle   patXData;    // Expanded Pattern data (internal use).
    short    patXValid;   // Flags whether expanded Pattern valid.
    Handle   patXMap;     // Handle to expanded Pattern data (reserved).
    Pattern  pat1Data;    // Bit map's data.
};
typedef struct PixPat PixPat;
typedef PixPat *PixPatPtr;
typedef PixPatPtr *PixPatHandle;

```

## Pattern

```

struct Pattern
{
    UInt8    pat[8];
};
typedef struct Pattern Pattern;
typedef Pattern *PatPtr;
typedef PatPtr *PatHandle;

```

## GDevice

```

struct GDevice
{
    short    gdRefNum;    // Reference Number of Driver.
    short    gdID;        // Client ID for search procedures.
    short    gdType;      // Type of device (indexed or direct).
    ITabHandle gdITable;  // Handle to inverse lookup table for Color Manager.
    short    gdResPref;   // Preferred resolution.
    SProcHndl gdSearchProc; // Handle to list of search functions.
    CProcHndl gdCompProc; // Handle to list of complement functions.
};

```

```

short      gdFlags;          // Graphics device flags.
PixMapHandle gdPMap;         // Handle to pixel map for displayed image.
long       gdRefCon;         // Reference value.
Handle     gdNextGD;         // Handle to next GDevice structure.
Rect       gdRect;          // Device's global boundaries.
long       gdMode;          // Device's current mode.
short      gdCCBytes;        // Width of expanded cursor data.
short      gdCCDepth;        // Depth of expanded cursor data.
Handle     gdCCXData;        // Handle to cursor's expanded data.
Handle     gdCCXMask;        // Handle to cursor's expanded mask.
long       gdReserved;       // (Reserved. Must be 0.)
};
typedef struct GDevice GDevice;
typedef GDevice *GDPtr, **GDHandle;

```

## Functions

### Opening and Closing Graphics Ports

```

CGrafPtr    CreateNewPort(void);
Void        DisposePort(CGrafPtr port);

```

### Saving and Restoring Graphics Ports

```

void        GetPort(GrafPtr *port);
void        SetPort(GrafPtr port);
void        SetPortDialogPort(DialogPtr dialog);
void        SetPortWindowPort(WindowRef window);

```

### Getting a Pointer to the Owning Window

```

WindowRef   GetWindowFromPort(CGrafPtr port);

```

### Graphics Port Accessors

```

PixMapHandle GetPortPixMap(CGrafPtr port);
Rect         GetPortBounds(CGrafPtr port, Rect *rect);
void         SetPortBounds(CGrafPtr port, const Rect *rect);
RgnHandle    GetPortVisibleRegion(CGrafPtr port, RgnHandle visRgn);
void         SetPortVisibleRegion(CGrafPtr port, RgnHandle visRgn);
RgnHandle    GetPortClipRegion(CGrafPtr port, RgnHandle clipRgn);
void         SetPortClipRegion(CGrafPtr port, RgnHandle clipRgn);
void         SetClip(RgnHandle rgn);
RGBColor     GetPortForeColor(CGrafPtr port, RGBColor *foreColor);
void         RGBForeColor(const RGBColor *color);
RGBColor     GetPortBackColor(CGrafPtr port, RGBColor *backColor);
void         RGBBackColor(const RGBColor *color);
PixPatHandle GetPortBackPixPat(CGrafPtr port, PixPatHandle backPattern);
void         SetPortBackPixPat(CGrafPtr port, PixPatHandle backPattern);
void         BackPat(const Pattern *pat);
PixPatHandle GetPortPenPixPat(CGrafPtr port, PixPatHandle penPattern);
void         SetPortPenPixPat(CGrafPtr port, PixPatHandle penPattern);
void         PenPat(const Pattern *pat);

```

```

PixPatHandle  GetPortFillPixPat(CGrafPtr port, PixPatHandle fillPattern);
Point         GetPortPenLocation(CGrafPtr port, Point *penLocation);
void         MoveTo(short h, short v);
Point         GetPortPenSize(CGrafPtr port, Point *penSize);
void         SetPortPenSize(CGrafPtr port, Point penSize);
void         PenSize(short width, short height);
SInt32        GetPortPenMode(CGrafPtr port);
void         SetPortPenMode(CGrafPtr port, SInt32 penMode);
void         PenMode(short mode);
short         GetPortTextFont(CGrafPtr port);
void         TextFont(short font);
void         HidePen(void);
void         ShowPen(void);
short         GetPortPenVisibility(CGrafPtr port);
short         GetPortTextSize(CGrafPtr port);
void         TextSize(short size);
Style         GetPortTextFace(CGrafPtr port);
void         TextFace(StyleParameter face);
short         GetPortTextMode(CGrafPtr port);
void         TextMode(short mode);
RGBColor      GetPortHiliteColor(CGrafPtr port, RGBColor *hiliteColor);

```

## Creating, Setting, Disposing of, and Accessing Pixel Maps

```

PixMapHandle  NewPixMap(void);
void         CopyPixMap(PixMapHandle srcPM, PixMapHandle dstPM);
void         SetPortPix(PixMapHandle pm);
void         DisposePixMap(PixMapHandle pm);
Rect          GetPixBounds(PixMapHandle pixMap, Rect *bounds);
short         GetPixDepth(PixMapHandle pixMap);

```

## Creating, Setting and Disposing of Graphics Device Structures

```

GDHandle      NewGDevice(short refNum, long mode);
void         InitGDevice(short qdRefNum, long mode, GDHandle gdh);
void         SetDeviceAttribute(GDHandle gdh, short attribute, Boolean value);
void         SetGDevice(GDHandle gd);
void         DisposeGDevice(GDHandle gdh);

```

## Getting the Available Graphics Devices

```

GDHandle      GetGDevice(void);
GDHandle      GetMainDevice(void);
GDHandle      GetNextDevice(GDHandle curDevice);
GDHandle      GetDeviceList(void);

```

## Determining the Characteristics of a Video Device

```

Boolean       TestDeviceAttribute(GDHandle gdh, short attribute);
void         ScreenRes(short *scrnHRes, short *scrnVRes);

```

## Changing the Pixel Depth of a Video Device

```

OSErr         SetDepth(GDHandle gd, short depth, short whichFlags, short flags);
short         HasDepth(GDHandle gd, short depth, short whichFlags, short flags);

```

## Demonstration Program PreQuickDraw Listing

```
// *****
// PreQuickDraw.c                                     CLASSIC EVENT MODEL
// *****
//
// This program opens a window in which is displayed some information retrieved from the
// GDevice structure for the main video device, from the graphics port's pixel map, and from
// the graphics port object using QuickDraw functions.
//
// A Demonstration menu allows the user to set the monitor to various pixel depths and to
// restore the original pixel depth. Setting the monitor to a pixel depth of 8 (256 colors)
// or less causes the colors in the color table to be displayed.
//
// The program utilises 'plst', 'MBAR', 'MENU', 'WIND', and 'STR#' resources, and a 'SIZE'
// resource with the acceptSuspendResumeEvents, canBackground, doesActivateOnFGSwitch, and
// isHighLevelEventAware flags set.
//
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenubar          128
#define rWindow           128
#define mAppleApplication 128
#define iAbout            1
#define mFile             129
#define iQuit             12
#define mDemonstration    131
#define iSetDepth8        1
#define iSetDepth16       2
#define iSetDepth32       3
#define iRestoreStartDepth 5
#define rIndexedStrings   128
#define sMonitorInadequate 1
#define sMonitorAtThatDepth 2
#define sMonitorAtStartDepth 3
#define sRestoringMonitor 4
#define MAX_UINT32        0xFFFFFFFF

// ..... global variables

Boolean gDone;
SInt16 gStartupPixelDepth;

// ..... function prototypes

void main (void);
void doPreliminaries (void);
```

```

OSErr  quitAppEventHandler      (AppleEvent *,AppleEvent *,SInt32);
void    doEvents                (EventRecord *);
void    doDisplayInformation     (WindowRef);
Boolean doCheckMonitor          (void);
void    doSetMonitorPixelDepth  (SInt16);
void    doRestoreMonitorPixelDepth (void);
void    doMonitorAlert           (Str255);

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;
    MenuRef        menuRef;
    WindowRef      windowRef;
    SInt16         entries = 0;
    Str255         theString;
    EventRecord     EventStructure;

    // ..... do preliminaries

    doPreliminaries();

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMenuBar);
    if(menubarHdl == NULL)
        ExitToShell();
    SetMenuBar(menubarHdl);
    DrawMenuBar();

    Gestalt(gestaltMenuMgrAttr,&response);
    if(response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
        {
            DeleteMenuItem(menuRef,iQuit);
            DeleteMenuItem(menuRef,iQuit - 1);
            DisableMenuItem(menuRef,0);
        }
    }

    // ..... check if monitor can display at least 16-bit color

    if(!doCheckMonitor())
    {
        GetIndString(theString,rIndexedStrings,sMonitorInadequate);
        doMonitorAlert(theString);
    }
}

```



```

// ..... open windows, set font, show windows, move windows

if(!(windowRef = GetNewCWindow(rWindow,NULL,(WindowRef)-1)))
    ExitToShell();

SetPortWindowPort(windowRef);
TextSize(10);

// ..... enter eventLoop

gDone = false;

while(!gDone)
{
    if(WaitNextEvent(everyEvent,&EventStructure,MAX_UINT32,NULL))
        doEvents(&EventStructure);
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    OSErr osError;

    MoreMasterPointers(32);
    InitCursor();
    FlushEvents(everyEvent,0);

    osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
                                   NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
                                   0L,false);

    if(osError != noErr)
        ExitToShell();
}

// ***** doQuitAppEvent

OSErr quitAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,SInt32 handlerRefcon)
{
    OSErr osError;
    DescType returnedType;
    Size actualSize;

    osError = AEGetAttributePtr(appEvent,keyMissedKeywordAttr,typeWildCard,&returnedType,NULL,0,
                                &actualSize);

    if(osError == errAEDescNotFound)
    {
        gDone = true;
        osError = noErr;
    }
    else if(osError == noErr)
        osError = errAEParmMissed;
}

```

```

    return osError;
}

// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    SInt32      menuChoice;
    MenuID      menuID;
    MenuItemIndex menuItem;
    WindowPartCode partCode;
    WindowRef   windowRef;
    Rect        portRect;

    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEResponseAppleEvent(eventStrucPtr);
            break;

        case keyDown:
            if((eventStrucPtr->modifiers & cmdKey) != 0)
            {
                menuChoice = MenuEvent(eventStrucPtr);
                menuID = HiWord(menuChoice);
                menuItem = LoWord(menuChoice);
                if(menuID == mFile && menuItem == iQuit)
                    gDone = true;
            }
            break;

        case mouseDown:
            if(partCode = FindWindow(eventStrucPtr->where,&windowRef))
            {
                switch(partCode)
                {
                    case inMenuBar:
                        menuChoice = MenuSelect(eventStrucPtr->where);
                        menuID = HiWord(menuChoice);
                        menuItem = LoWord(menuChoice);

                        if(menuID == 0)
                            return;

                        switch(menuID)
                        {
                            case mAppleApplication:
                                if(menuItem == iAbout)
                                    SysBeep(10);
                                break;

                            case mFile:
                                if(menuItem == iQuit)
                                    gDone = true;
                                break;

```

```

        case mDemonstration:
            if(menuItem == iSetDepth8)
                doSetMonitorPixelFormatDepth(8);
            else if(menuItem == iSetDepth16)
                doSetMonitorPixelFormatDepth(16);
            else if(menuItem == iSetDepth32)
                doSetMonitorPixelFormatDepth(32);
            else if(menuItem == iRestoreStartDepth)
                doRestoreMonitorPixelFormatDepth();
            break;
        }
        HiliteMenu(0);
        break;

    case inDrag:
        DragWindow(windowRef, eventStrucPtr->where, NULL);
        GetWindowPortBounds(windowRef, &portRect);
        InvalWindowRect(windowRef, &portRect);
        break;
    }
}
break;

case updateEvt:
    windowRef = (WindowRef) eventStrucPtr->message;
    BeginUpdate(windowRef);
    SetPortWindowPort(windowRef);
    doDisplayInformation(windowRef);
    EndUpdate(windowRef);
    break;
}
}

// ***** doDisplayInformation

void doDisplayInformation(WindowRef windowRef)
{
    RGBColor    whiteColor = { 0xFFFF, 0xFFFF, 0xFFFF };
    RGBColor    blueColor  = { 0x3333, 0x3333, 0x9999 };
    Rect        portRect;
    GDHandle    deviceHdl;
    SInt16      videoDeviceCount = 0;
    Str255      theString;
    SInt16      deviceType, pixelDepth, bytesPerRow;
    Rect        theRect;
    GrafPtr     grafPort;
    PixMapHandle pixMapHdl;
    CTabHandle   colorTableHdl;
    SInt16      entries = 0, vert = 28, horiz = 250, index = 0;
    RGBColor    getPixelFormat, colorTableColor;

    RGBForeColor(&whiteColor);
    RGBBackColor(&blueColor);
    GetWindowPortBounds(windowRef, &portRect);

```

```

EraseRect(&portRect);
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);

// ..... Get Device List

deviceHdl = GetDeviceList();

// ..... count video devices in device list

while(deviceHdl != NULL)
{
    if(TestDeviceAttribute(deviceHdl,screenDevice))
        videoDeviceCount ++;

    deviceHdl = GetNextDevice(deviceHdl);
}

NumToString(videoDeviceCount,theString);
MoveTo(10,20);
DrawString(theString);
if(videoDeviceCount < 2)
    DrawString("\p video device in the device list.");
else
    DrawString("\p video devices in the device list.");

// ..... Get Main Device

deviceHdl = GetMainDevice();

// ..... determine device type

MoveTo(10,35);

if(((1 << gdDevType) & (*deviceHdl)->gdFlags) != 0)
    DrawString("\pThe main video device is a color device.");
else
    DrawString("\pThe main video device is a monochrome device.");

MoveTo(10,50);
deviceType = (*deviceHdl)->gdType;
switch(deviceType)
{
    case clutType:
        DrawString("\pIt is an indexed device with variable CLUT.");
        break;

    case fixedType:
        DrawString("\pIt is is an indexed device with fixed CLUT.");
        break;

    case directType:
        DrawString("\pIt is a direct device.");
        break;
}

```

```

// ..... Get Handle to Pixel Map

grafPort = GetWindowPort(windowRef);
pixMapHdl = GetPortPixMap(grafPort);
// pixMapHdl = (*deviceHdl)->gdPMap; // alternative method

// ..... get and display pixel depth

MoveTo(10,70);
DrawString("\pPixel depth = ");

pixelDepth = GetPixDepth(pixMapHdl);
// pixelDepth = (*deviceHdl)->gdPMap->pixelSize; // alternative method

NumToString(pixelDepth,theString);
DrawString(theString);

// ..... get and display bytes per row

MoveTo(10,90);
bytesPerRow = (*pixMapHdl)->rowBytes & 0x7FFF;
DrawString("\pBytes per row = ");
NumToString(bytesPerRow,theString);
DrawString(theString);

// ..... Get Device's Global Boundary Rectangle

theRect = (*deviceHdl)->gdRect;

// ..... calculate and display total pixel image bytes

MoveTo(10,105);
DrawString("\pTotal pixel image bytes = ");
NumToString(bytesPerRow * theRect.bottom,theString);
DrawString(theString);

// ..... display device's boundary rectangle

MoveTo(10,130);
TextFace(bold);
DrawString("\pGraphics Device's Boundary Rectangle");
TextFace(normal);
MoveTo(10,145);
DrawString("\p(gdRect field of GDevice structure)");

MoveTo(10,160);
DrawString("\pBoundary rectangle top = ");
NumToString(theRect.top,theString);
DrawString(theString);

MoveTo(10,175);
DrawString("\pBoundary rectangle left = ");
NumToString(theRect.left,theString);
DrawString(theString);

```

```

MoveTo(10,190);
DrawString("\pBoundary rectangle bottom = ");
NumToString(theRect.bottom,theString);
DrawString(theString);

MoveTo(10,205);
DrawString("\pBoundary rectangle right = ");
NumToString(theRect.right,theString);
DrawString(theString);

// ..... Get and Display Pixel Map's Boundary Rectangle

GetPixBounds(pixmapHdl,&theRect);

MoveTo(10,225);
TextFace(bold);
DrawString("\pPixel Map's Boundary Rectangle");
TextFace(normal);
MoveTo(10,240);
DrawString("\p(bounds field of PixMap structure)");

MoveTo(10,255);
DrawString("\pBoundary rectangle top = ");
NumToString(theRect.top,theString);
DrawString(theString);

MoveTo(10,270);
DrawString("\pBoundary rectangle left = ");
NumToString(theRect.left,theString);
DrawString(theString);

MoveTo(10,285);
DrawString("\pBoundary rectangle bottom = ");
NumToString(theRect.bottom,theString);
DrawString(theString);

MoveTo(10,300);
DrawString("\pBoundary rectangle right = ");
NumToString(theRect.right,theString);
DrawString(theString);

MoveTo(10,320);
DrawString("\pOn Mac OS X, drag window after pixel depth and screen resolution changes to");
DrawString("\p ensure that");
MoveTo(10,333);
DrawString("\pbytes per row, pixel image bytes, and color values are updated.");

// ..... Get and Display RGB Components of Requested Background Color

MoveTo(250,255);
GetBackColor(&blueColor);
DrawString("\pRequested background color (rgb) = ");
MoveTo(250,270);
NumToString(blueColor.red,theString);

```

```

DrawString(theString);
DrawString("\p ");
NumToString(blueColor.green,theString);
DrawString(theString);
DrawString("\p ");
NumToString(blueColor.blue,theString);
DrawString(theString);

// ..... If Direct Device, Get and Display RGB Components of Color Returned by GetCPixel

if(deviceType == directType)
{
    MoveTo(250,285);
    GetCPixel(10,10,&getPixelColor);
    DrawString("\pColor returned by GetCPixel (rgb) = ");
    MoveTo(250,300);
    NumToString(getPixelColor.red,theString);
    DrawString(theString);
    DrawString("\p ");
    NumToString(getPixelColor.green,theString);
    DrawString(theString);
    DrawString("\p ");
    NumToString(getPixelColor.blue,theString);
    DrawString(theString);
}

// ..... else prepare to display color table index

else
{
    MoveTo(250,285);
    DrawString("\pBackground color (color table index):");
}

// ..... Get Handle to Color Table

colorTableHdl = (*pixmapHdl)->pmTable;

// ..... if any entries in color table, draw the colors

MoveTo(250,20);
DrawString("\pColor table:");

entries = (*colorTableHdl)->ctSize;

if(entries < 2)
{
    MoveTo(260,100);
    DrawString("\pOnly one (dummy) entry in the color");
    MoveTo(260,115);
    DrawString("\ptable. To cause the color table to be");
    MoveTo(260,130);
    DrawString("\pbuilt, set the monitor to bit depth 8");
    MoveTo(260,145);

```



```

    DrawString("\p(256 colors), causing it to act like ");
    MoveTo(260,160);
    DrawString("\pan indexed device.");
    SetRect(&theRect,250,28,458,236);
    FrameRect(&theRect);
}

for(index = 0;index <= entries;index++)
{
    SetRect(&theRect,horiz,vert,horiz+12,vert+12);
    colorTableColor = (*colorTableHdl)->ctTable[index].rgb;
    RGBForeColor(&colorTableColor);
    PaintRect(&theRect);

    // .... also, if device is not a direct device, and current color matches background ...

    if(deviceType == clutType || deviceType == fixedType)
    {
        if(colorTableColor.red == blueColor.red &&
            colorTableColor.green == blueColor.green &&
            colorTableColor.blue == blueColor.blue)
        {

            // ..... outline the drawn color and display the color table index

            RGBForeColor(&whiteColor);
            InsetRect(&theRect,-1,-1);
            FrameRect(&theRect);
            MoveTo(250,300);
            NumToString(index,theString);
            DrawString(theString);
        }
    }

    horiz += 13;
    if(horiz > 445)
    {
        horiz = 250;
        vert += 13;
    }
}

GDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
}

// ***** doCheckMonitor

Boolean doCheckMonitor(void)
{
    GDHandle mainDeviceHdl;

    mainDeviceHdl = GetMainDevice();

```

```

    if(! (HasDepth(mainDeviceHdl,16,gdDevType,1)))
    {
        DisableMenuItem(GetMenuRef(mDemonstration),0);
        return false;
    }
    else
    {
        gStartupPixelFormat = (**(mainDeviceHdl).gdPMap).pixelSize;
        return true;
    }
}

// ***** doSetMonitorPixelFormat

void doSetMonitorPixelFormat(SInt16 requiredDepth)
{
    GDHandle mainDeviceHdl;
    Str255 alertString;
    SInt16 currentPixelFormat;

    mainDeviceHdl = GetMainDevice();
    currentPixelFormat = (**(mainDeviceHdl).gdPMap).pixelSize;

    if(currentPixelFormat != requiredDepth)
    {
        SetDepth(mainDeviceHdl,requiredDepth,gdDevType,1);
    }
    else
    {
        GetIndString(alertString,rIndexedStrings,sMonitorAtThatDepth);
        doMonitorAlert(alertString);
    }
}

// ***** doRestoreMonitorPixelFormat

void doRestoreMonitorPixelFormat(void)
{
    GDHandle mainDeviceHdl;
    Str255 alertString;
    SInt16 pixelDepth;

    mainDeviceHdl = GetMainDevice();
    pixelDepth = (**(mainDeviceHdl).gdPMap).pixelSize;

    if(pixelDepth != gStartupPixelFormat)
    {
        GetIndString(alertString,rIndexedStrings,sRestoringMonitor);
        doMonitorAlert(alertString);
        SetDepth(mainDeviceHdl,gStartupPixelFormat,gdDevType,1);
    }
    else

```

```

{
    GetIndString(alertString,rIndexedStrings,sMonitorAtStartDepth);
    doMonitorAlert(alertString);
}
}

// ***** doMonitorAlert

void doMonitorAlert(Str255 labelText)
{
    SInt16 itemHit;

    StandardAlert(kAlertNoteAlert,labelText,NULL,NULL,&itemHit);
}

// *****

```

## Demonstration Program PreQuickDraw Comments

When this program is run, the user should

- Drag the window to various positions on the main screen, noting, on Mac OS 8/9 only, the changes to the coordinates of the pixel map's boundary rectangle. (On Mac OS X these coordinates represent the bounds of the Core Graphics window that backs the Carbon window, not the screen.)
- Change between the available monitor resolutions, noting the changes in the bytes per row and total pixel image bytes figures displayed in the window.
- Using the Demonstration menu, change between the available pixel depths, noting the changes to the pixel depth and total pixel image bytes figures, and the background color values, displayed in the window.
- Note that, when a pixel depth of 8 is set on a direct device, the device creates a CLUT and operates like a direct device. In this case, the background color value is the color table entry (index), and the relevant color in the color table display is framed in white.

On Mac OS 8/9, if the user's monitor is set to thousands or millions of colors when the program is run for the first time, the color table will not be built. It will be built when the user first sets the pixel depth to 8 (256 colors).

### main

The call to `doCheckMonitor` determines whether the monitor can support a pixel depth of at least 16. If it cannot, the Demonstration menu is disabled, false is returned, and an alert is displayed advising the user that the Demonstration menu will be unavailable. If the monitor can support a pixel depth of at least 16, the current pixel depth is assigned to the global variable `gStartupPixelFormat`.

**doEvents**

In the case of a mouse-down event, in the `inDrag` case, when the user releases the mouse button, the window is invalidated, causing it to be redrawn.

**doDisplayInformation**

At the first two lines, RGB colors are assigned to the window's graphics port's `rgbFgColor` and `U` fields. The call to `EraseRect` causes the content region to be filled with the background color.

**Get Device List**

The call to `GetDeviceList` gets a handle to the first `GDevice` structure in the device list. The device list is then "walked" in the while loop. For every video device found in the list, the variable `videoDeviceCount` is incremented. `GetNextDevice` gets a handle to the next device in the device list.

**Get Main Device**

`GetMainDevice` gets a handle to the startup device, that is, the device on which the menu bar appears.

Following the call to `MoveTo`, the `gdDevType` bit is tested to determine whether the main (startup) device is a color or black-and-white device.

In the next block, the `gdType` field of the `GDevice` structure is examined to determine whether the device is an indexed device with a variable CLUT, an indexed device with a fixed CLUT, or a direct device (or a direct device set to display 256 colors or less and, as a consequence, acting like an indexed device).

**Get Handle to Pixel Map**

The call to `GetWindowPort` gets the reference to the window's graphics port required by the call to `GetPortPixMap`. `GetPortPixMap` gets a handle to the pixel map. (The following line shows an alternative method of obtaining a handle to a pixel map, in this case from the `GDevice` structure.)

In the next block, `GetPixDepth` is called to get the pixel depth. (The following line shows an alternative method of obtaining the pixel depth, in this case from the `GDevice` structure.)

At the next block, the number of bytes in each row in the pixel map is determined. (The high bit in the `rowBytes` field of the `PixMap` structure is a flag which indicates whether the data structure is a `PixMap` structure or a `BitMap` structure.)

**Get Device's Boundary Rectangle**

At the first line of this block, the device's boundary rectangle is extracted from the `GDevice` structure's `gdRect` field.

At the next block, the bytes per row value is multiplied by the height of the boundary rectangle to arrive at the total number of bytes in the pixel image.

The boundary rectangle's top, left, bottom, and right coordinates are then drawn in the window.

### ***Get and Display Pixel Map's Boundary Rectangle***

The call to `GetPixBounds` gets the pixel map's bounding rectangle. The rectangle's top, left, bottom, and right coordinates are then drawn in the window.

### ***Get and Display RGB Components of Requested Background Color***

The second line of this block calls `GetBackColor` to get the graphics port's background color. The red, green, and blue values are then printed in the window.

### ***If Direct Device, Get and Display RGB Components of Color Returned by GetCPixel***

If the device is a direct device, `GetCPixel` is called to get the color of a pixel in the window drawn with the background color. The red, green and blue values are then printed in the window.

If the device is not a direct device, some preparatory text is drawn in the window.

### ***Get Handle To Color Table***

The first and fourth lines get a handle to the color table in the `GDevice` structure's pixel map and the number of entries in that table. (Note that the `ctSize` field of the `ColorTable` structure contains the number of table entries minus one.)

On Mac OS 8/9, QuickDraw only calls the Color Manager to build the color table if the device is an indexed device (or a direct device acting as an indexed device). Thus, on Mac OS 8/9, there will only be a dummy entry in the color table unless the monitor is an indexed device or a direct device set to display 256 colors or less.

The final block paints small colored rectangles for each entry in the color table. If the main device is an indexed device (or if it is a direct device set to display 256 colors or less), the color table entry being used as the best match for the requested background color is outlined in white and the index value is drawn.

### ***doCheckMonitor***

`doCheckMonitor` is called at program start to determine whether the main device supports at least 16-bit color and, if it does, to assign the main device's pixel depth at startup to the global variable `gStartupPixelFormat`.

The call to `GetMainDevice` gets a handle to the main device's `GDevice` structure. The function `HasDepth` is used to determine whether the device supports at least 16-bit color. If it does not, the Demonstration menu is disabled and false is returned. If it does, the pixel depth is extracted from the `pixelSize` field of the `PixelFormat` structure in the `GDevice` structure and assigned to the global variable `gStartupPixelFormat`.

### **doSetMonitorPixelFormat**

`doSetMonitorPixelFormat` is called when one of the the first three items in the Demonstration menu is chosen.

If the current pixel depth determined at the first two lines is not equal to the required new depth, `SetDepth` is called to set the main device's pixel depth to the required depth.

If the current pixel depth is equal to the required pixel depth, an alert is displayed advising the user that the device is currently set to that pixel depth.

### **doRestoreMonitorPixelFormat**

`doRestoreMonitorPixelFormat` is called, when the last item in the Demonstration menu is chosen, to reset the main device's pixel depth to the startup pixel depth.

If the current pixel depth determined at the first two lines is not equal to the startup pixel depth, a string is retrieved from a 'STR#' resource and passed to the function `doMonitorAlert`, which displays a movable modal alert box advising the user that the monitor's bit depth is about to be changed to the startup pixel depth. When the user dismisses the alert box, `SetDepth` sets the main device's pixel depth to the startup pixel depth.

If the current pixel depth is the startup pixel depth, the last two lines display an alert box advising the user that the device is currently set to that pixel depth.



# Drawing with QuickDraw

## CHAPTER

# 12

## IN THIS CHAPTER

- Introduction 532
- The Coordinate Plane, Points, Rectangles, and Regions 532
- The Graphics Pen, Foreground and Background Colors, Pixel Patterns and Bit Patterns, and Transfer Modes 535
- Drawing Lines and Framed Shapes 540
- Drawing Painted and Filled Shapes 542
- Erasing and Inverting Shapes 544
- Drawing Pictures 545
- Drawing Text 545
- Copying Pixel Images Between Graphics Ports 547
- Scrolling Pixels in the Port Rectangle 549
- Manipulating Rectangles and Regions 549
- Highlighting 551
- Drawing Other Graphics Entities 551
- Saving and Restoring the Graphics Port Drawing State 552
- Main QuickDraw Constants, Data Types and Functions 553
- Relevant Appearance Manager Data Types and Functions 558
- Demonstration Program QuickDraw Listing 559
- Demonstration Program QuickDraw Comments 589



## Introduction

As stated in Chapter 11, QuickDraw is a collection of system software routines that your application uses to perform imaging operations—that is, the construction and display of graphical information for display on output devices such as screens and printers.

## The Coordinate Plane, Points, Rectangles, and Regions

The following mathematical constructs are widely used in QuickDraw's functions and data types:

- The coordinate plane
- The point
- The rectangle
- The region

### The Coordinate Plane

A Macintosh screen (or screens) represents part of a global coordinate plane bounded by the limits of QuickDraw coordinates (–32768 to 32767). The (0,0) origin point of this global coordinate plane is at the upper-left corner of the main screen. From the upper-left coordinate of the main screen, coordinate values decrease to the left and up and increase to the right and down. Any pixel on the screen can be specified by a vertical coordinate and a horizontal coordinate.

In addition to the global coordinate system, QuickDraw maintains a **local coordinate system** for every window's graphics port. The relationship between local and global coordinates is shown in Fig 1.

### Points

The location on the coordinate plane where imaginary horizontal and vertical grid lines intersect is called a **point**. Points themselves are dimensionless whereas a pixel is not. As shown in Fig 2, a pixel “hangs” down and to the right of the point by which it is addressed. A pixel thus lies between the infinitely thin lines of the coordinate grid.

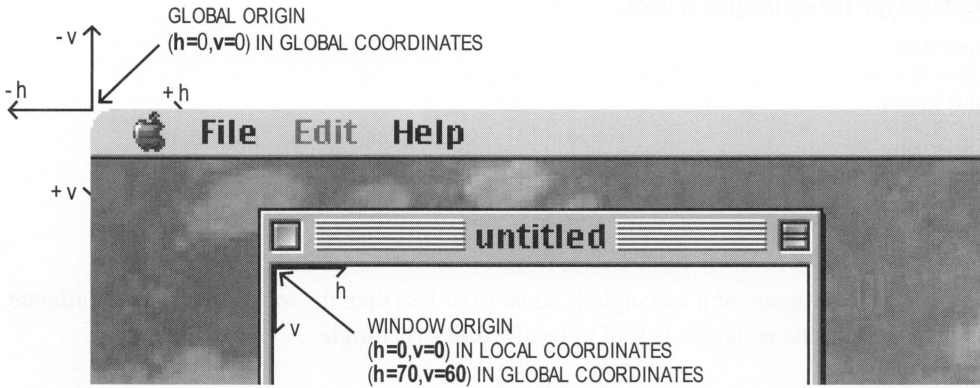


FIG 1 - LOCAL AND GLOBAL COORDINATE SYSTEMS

12

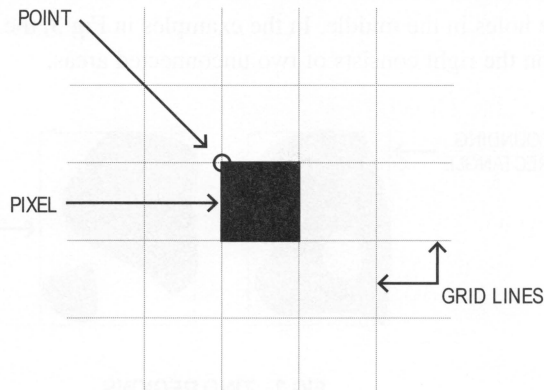
DRAWING WITH  
QUICKDRAW

FIG 2 - A POINT AND A PIXEL

The data type for points is `Point`:

```
struct Point
{
    short v; // Vertical coordinate.
    short h; // Horizontal coordinate.
};
typedef struct Point Point;
typedef Point *PointPtr;
```

## Rectangles

A **rectangle**, whose borders are infinitely thin in the same way that a point is infinitely small, is used to define an area on the screen.

The data type for rectangles is `Rect`:

```
struct Rect
{
    short top;
    short left;
    short bottom;
    short right;
};
typedef struct Rect Rect;
typedef Rect *RectPtr;
```

If the bottom coordinate of a rectangle is equal to or less than the top, or the right coordinate is less than the left, the rectangle is said to be an **empty rectangle**.

## Regions

A **region** is an arbitrary area, or set of areas, the outline of which is one or more closed loops. A region can be concave or convex, can consist of one connected area or many separate ones, and can even have holes in the middle. In the examples in Fig 3, the region on the left has a hole and the one on the right consists of two unconnected areas.

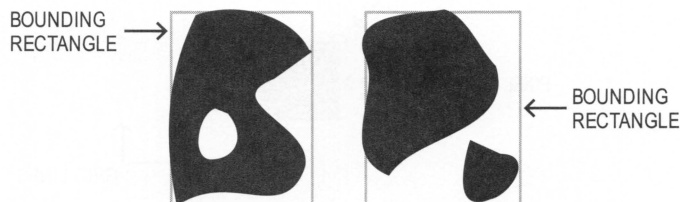


FIG 3 - TWO REGIONS

## Region Objects and Accessor Functions

QuickDraw stores information about regions in opaque data structures called **region objects**. The data type `RgnHandle` is defined as a reference to a region object:

```
typedef struct OpaqueRgnHandle* RgnHandle;
```

One accessor function is provided to access the information in region objects:

<i>Function</i>	<i>Description</i>
<code>GetRegionBounds</code>	Get the region's bounding rectangle.

For a region which is a rectangle, the rectangle returned by `GetRegionBounds` defines the entire region. The data for more complex regions is stored in the region object in a proprietary

format. The function `IsRegionRectangular` may be used to determine whether a specific region is rectangular.

## The Graphics Pen, Foreground and Background Colors, Pixel Patterns and Bit Patterns, and Transfer Modes

### The Graphics Pen

The metaphorical graphics pen used for drawing lines and shapes in a graphics port is rectangular in shape and its size (that is, its height and width) is measured in pixels. Whenever you draw into a graphics port, the characteristics of the graphics pen determine how the drawing looks. Those characteristics are as follows:

- Pen **location**, which is specified in local coordinates stored in the graphics port. The functions `Move` and `MoveTo` are used to move the pen to a specified location, and the function `GetPen` gets the pen's current location.
- Pen **size**, which is specified by the a width and a height (in pixels) stored in the graphics port. The pen's default size is one-by-one pixel; however, `PenSize` can be used to change the size and shape up to a 32,767-by-32,767 pixel square. Note that if either the width or height is set to 0, the pen does not draw.
- Pen **color**, that is, the graphics port's foreground color.
- Pen **pattern**, which defines the pattern that the pen draws with.
- Pen **transfer mode**, a Boolean or arithmetic operation which determines how QuickDraw transfers the pen pattern to the pixel map during drawing operations.
- Pen **visibility**, which is specified by an integer stored in the graphics port, indicating whether drawing operations will actually appear. For example, for 0 or negative values, the pen draws with "invisible ink". The functions `ShowPen` and `HidePen` are used to change pen visibility.

### Getting and Setting the Pen State

The following functions are used to get and set the current pen state:

<i>Function</i>	<i>Description</i>
<code>GetPenState</code>	Returns, in a <code>PenState</code> structure, the graphics pen's current location, size, transfer mode, and pattern.
<code>SetPenState</code>	Using information supplied by a <code>PenState</code> structure, sets the graphics pen's location, size, transfer mode, and pattern.
<code>PenNormal</code>	Resets the pen size, transfer mode, and pattern to the state initialized when the graphics port was opened.

## Foreground and Background Color

### Foreground Color

The function `RGBForeColor` is used to set the foreground color in the graphics port. You may also use the Palette Manager function `PmForeColor` to set the foreground color.

The foreground color is used by the graphics pen for **drawing** lines, framed shapes, and text. The foreground color is also used by QuickDraw shape **painting** functions.

### Background Color

The function `RGBBackColor` is used to set the background color in the graphics port. You may also use the Palette Manager function `PmBackColor` to set the background color.

The background color is used by QuickDraw **erasing** functions, and is also used by the `ScrollRect` function to replace the scrolled pixels.

## Pixel Patterns and Bit Patterns

### Pixel Patterns

If you wish to draw or paint with a color *pattern* rather than the color set by `RGBForeColor`, you can set the pen pixel pattern in the graphics port using `SetPortPenPixPat` or `PenPixPat`. (Initially, the pen pixel pattern in the graphics port is all-“black.” When you set a non-all-“black” pattern, the pen pattern in the graphics port overrides the foreground color.)

You define a pixel pattern in a 'ppat' resource. To retrieve the pixel pattern stored in the 'ppat' resource, you use the `GetPixPat` function. The handle to a `pixPat` data structure returned by `GetPixPat` may then be used in a call to `SetPortPenPixPat` or `PenPixPat` to set the pixel pattern.

Similarly, if you wish to erase with a pixel pattern rather than the background color, or replace the pixels scrolled by `ScrollRect` with a pixel pattern rather than the background color, you can set the background pixel pattern in the graphics port using `SetPortBackPixPat` or `BackPixPat`. (Initially, the background pixel pattern in the graphics port is all-“white.” When you assign a non-all-“white” pattern, the background pattern in the graphics port overrides the background color)

In addition to drawing, painting and erasing functions, QuickDraw includes shape **filling** functions, which may be used to fill a specified shape using a specified pixel pattern. A handle to a `pixPat` data structure is passed in the `thePPat` parameter of these functions.

### Bit Patterns

After drawing or painting with a pixel pattern, you can return to drawing or painting with the foreground color by simply restoring the default all-“black” pattern by calling `PenPat` and passing in the bit pattern contained in the QuickDraw global variable `black` as follows:

```
Pattern blackPattern;  
  
PenPat(GetQDGlobalsBlack(&blackPattern));
```

After erasing with a pixel pattern, you can return to erasing with the background color by simply restoring the default all-“white” pattern by calling `BackPat` and passing in the bit pattern contained in the QuickDraw global variable `white` as follows:

```
Pattern whitePattern;  
  
BackPat(GetQDGlobalsWhite(&whitePattern));
```

When you use the `PenPat` and `BackPat` functions, QuickDraw constructs a pixel pattern equivalent to the bit pattern. The graphics port’s current foreground color is used for the “black” bits in the bit pattern, and the background color is used for the “white” bits.

The `PenPat` and `BackPat` functions may also be used to set other bit patterns in the graphics port.

## Transfer Modes

The term **transfer mode** may be considered as a generic term encompassing three different transfer mode types. Each has to do with the way source pixels interact with destination pixels during drawing, painting, erasing, filling, and **copying** operations. The three types of transfer mode are as follows:

- **Boolean Pattern Mode.** Boolean pattern modes apply to line drawing, framing, painting, erasing, and filling operations.
- **Boolean Source Mode.** Boolean source modes apply to text drawing and copying operations.
- **Arithmetic Source Mode.** Arithmetic source modes apply to drawing (including text drawing), painting, and copying operations.

## Boolean Pattern Modes

Pattern modes may be set as pen transfer modes in the graphics port using the `PenMode` function. The modes are represented by eight constants, each of which relates to a specific Boolean operation (COPY, OR, XOR, and BIC (for bit clear)) and their inverse variants.

The effects of these modes are best explained assuming a 1-bit (black-and-white) environment in which the foreground color is black and the background color is white. The following lists the pattern modes and describes the effect of source pixels on destination pixels in such an environment.

<i>Pattern Mode</i>	<i>Action On Destination Pixel</i>	
	<i>If source pixel is black</i>	<i>If source pixel is white</i>
patCopy	Apply foreground color	Apply background color
patOr	Apply foreground color	Leave alone
patXor	Invert	Leave alone
patBic	Apply background color	Leave alone
notPatCopy	Apply background color	Apply foreground color
notPatOr	Leave alone	Force black
notPatXor	Leave alone	Invert
notPatBic	Leave alone	Apply background color

These effects are illustrated in Fig 4. Note particularly that patCopy causes the destination pixels to be completely over-written. patCopy is the transfer mode initially set in the graphics port.

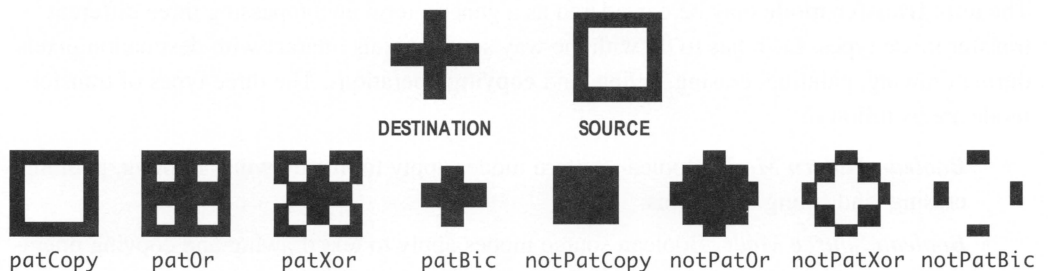


FIG 4 - EFFECT OF PATTERN MODES

## Boolean Source Modes

Boolean source modes may be set as text in the graphics port using the function `TextMode`, and may be passed as parameters in QuickDraw functions for copying pixel images. The Boolean source modes are the equivalent in text drawing and copying to the Boolean pattern mode used for non-text drawing, painting, filling, and erasing operations.

The relevant constants are `srcCopy`, `srcOr`, `srcXor`, `srcBic`, `notSrcCopy`, `notSrcOr`, `notSrcXor`, and `notSrcBic`. The additional non-standard mode `grayishTextOr` is useful for drawing text in deactivated or disabled user interface objects. (This mode is considered non-standard because it is not stored in pictures and printing with it is undefined.)



## Arithmetic Source Modes

Arithmetic source modes may be set in the graphics port, and may be passed as parameters in QuickDraw functions for copying pixel images.

Arithmetic source modes perform arithmetic operations on the values of the red, green and blue components of the source and destination pixels. Because they work with RGB colors rather than color table indexes, arithmetic transfer modes produce predictable results on indexed devices. The arithmetic source modes and their effects in a color environment are as follows:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
blend	32	Destination pixel is replaced with a blend of the source and destination pixel colors. Revert to srcCopy mode if the destination is a bitmap or 1-bit pixel image.
addPin	33	Destination pixel is replaced with the sum of the source and destination pixel colors up to a maximum allowable value. Revert to srcBic mode if the destination is a bitmap or 1-bit pixel image.
addOver	34	Destination pixel is replaced with the sum of the source and destination pixel colors, but if the value of the red, green or blue component exceeds 65,536, then subtract 65,536 from that value. Revert to srcXor mode if the destination is a bitmap or 1-bit pixel image.
subPin	35	Destination pixel is replaced with the difference of the source and destination pixel colors, but not less than a minimum allowable value. Revert to srcOr mode if the destination is a bitmap or 1-bit pixel image.
transparent	36	Source and destination pixel are replaced with the source pixel if the source pixel is not equal to the background color.
addMax	37	Destination pixel is replaced with the color containing the greater saturation of each of the RGB components of the source and destination pixels. Revert to srcBic mode if the destination is a bitmap or 1-bit pixel image.
subOver	38	Destination pixel is replaced with the difference of the source and destination pixel colors, but if the value of the red, green or blue is less than 0, add the negative result to 65,536. Revert to srcXor mode if the destination is a bitmap or 1-bit pixel image.
adMin	39	Destination pixel is replaced with the color containing the lesser saturation of each of the RGB components of the source and destination pixels. Revert to srcOr mode if the destination is a bitmap or 1-bit pixel image.

## Drawing Lines and Framed Shapes

### Functions for Drawing Lines

You can move the graphics pen to a specified location, and you can draw lines from that location. Lines are drawn using the current graphics pen size, foreground color or pen pixel/bit pattern, and pen pattern mode.

Functions for moving the graphics pen and drawing lines are as follows:

<i>Function</i>	<i>Description</i>
MoveTo	Moves the graphics pen location to the specified location, in local coordinates
Move	Moves the graphics pen a specified distance from its current location
LineTo	Draws a line from the current pen location to the specified location, in local coordinates
Line	Draws a line a specified distance from the graphics pen's current location

Fig 5 shows a line drawn with a pen of size 20-by-40 pixels. Note that the pen “hangs” below and to the right of the defining points,

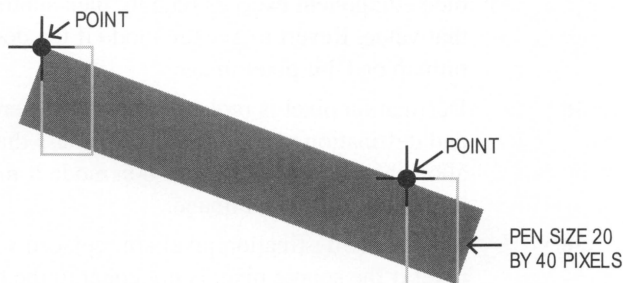


FIG 5 - A LINE DRAWN BY LineTo OR Line

### Functions for Drawing Framed Shapes

Framing a shape draws its outline only, using the current pen size, foreground color or pen pixel/bit pattern, and pen pattern mode. The pixels in the interior of the shape are unaffected. Framed shapes are drawn using the current graphics pen size, foreground color or pen pixel/bit pattern, and pen pattern mode.

Functions for drawing framed shapes are as follows:

Function	Description
FrameRect	Draws a rectangle, the position and size of which are defined by a Rect structure.
FrameOval	Draws an oval, the position and size of which are determined by a bounding rectangle defined by a Rect structure.
FrameRoundRect	Draws a rounded rectangle, the position and size of which are determined by a bounding rectangle defined by a Rect structure. Curvature of the corners is defined by ovalWidth and ovalHeight parameters.
FrameArc	Draws an arc, the position and size of which are determined by a bounding rectangle defined by a Rect structure. Starting point and arc extent are determined by startAngle and arcAngle parameters.
FramePoly	Draws a polygon by “playing back” all the line drawing calls that define it.
FrameRgn	Draws an outline around a specified region. The line is drawn just inside the region.

Fig 6 shows various framed shapes drawn with various graphics pen sizes and bit patterns. Note that the bounding rectangles completely enclose the shapes they bound, that is, no pixels extend outside the infinitely thin lines of the bounding rectangle. Note also that the arc is a portion of the circumference of an oval bounded by a pair of radii joining at the oval’s center.

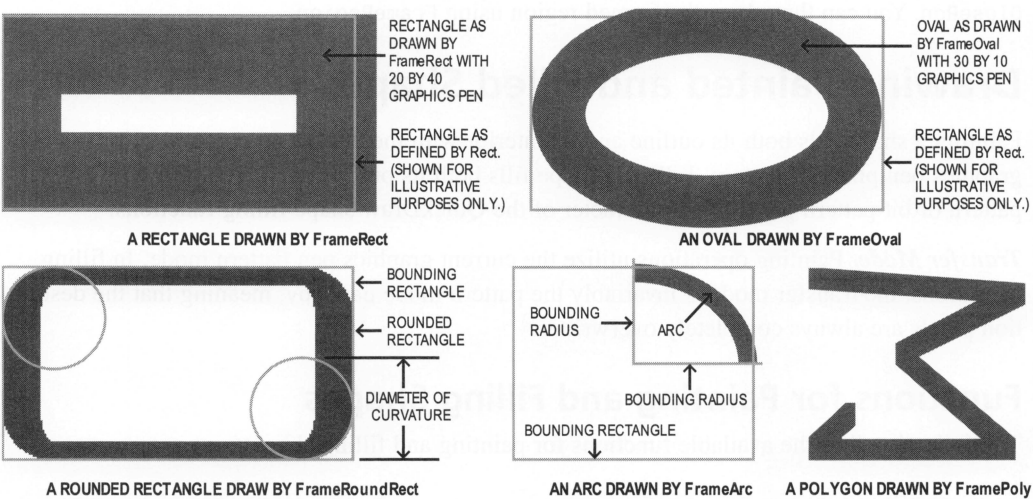


FIG 6 - FRAMED SHAPES DRAWN WITH QUICKDRAW FRAMED SHAPE DRAWING FUNCTIONS

## Framed Polygons and Regions

Framed polygons and regions require that you call several functions to create and draw them. You begin by calling a function that collects drawing commands into a definition for the object. You then use drawing functions to define the object before calling a function that signals the end of the object definition. Finally, you use a function which draws the newly defined object.

### Framed Polygons

To define a polygon you must first call `OpenPoly`. You then call `LineTo` a number of times to create lines from the first vertex to the second, from the second vertex to the third, and so on. You then call `ClosePoly`, which completes the definition process. After defining a polygon in this way, you can draw the polygon, as a framed polygon, using `FramePoly`.

Note that, in the framed polygon in Fig 5, the final defining line from the last vertex back to the first vertex was not drawn during the definition process. Note also that, as in all line drawing, `FramePoly` hangs the pen down and to the right of the infinitely thin lines that define the polygon.

### Framed Regions

To define a region, you can use any set of lines or shapes, including other regions, so long as the region's outline consists of one or more closed loops. First, however, you must call `NewRgn` and `OpenRgn`. You then use line, shape, or region drawing commands to define the region. When you have finished collecting commands to define the outline of the region, you call `CloseRgn`. You can then draw the framed region using `FrameRegion`.

## Drawing Painted and Filled Shapes

Painting a shape fills both its outline and its interior with the current foreground color or graphics pen pixel/bit pattern. Filling a shape fills both its outline and its interior with a pixel pattern or bit pattern passed in a parameter of the QuickDraw shape filling functions.

**Transfer Mode.** Painting operations utilize the current graphics pen pattern mode. In filling operations, the transfer mode is invariably the pattern mode `patCopy`, meaning that the destination pixels are always completely overwritten.

## Functions for Painting and Filling Shapes

The following lists the available functions for painting and filling shapes:

<i>Function</i>	<i>Description</i>
PaintRect	Fills a rectangle with the current foreground color or graphics pen pixel/ bit pattern.
PaintOval	Fills an oval with the current foreground color or graphics pen pixel/ bit pattern.
PaintRoundRect	Fills a round rectangle with the current foreground color or graphics pen pixel/ bit pattern.
PaintArc	Fills a wedge with the current foreground color or graphics pen pixel/ bit pattern.
PaintPoly	Fills a polygon with the current foreground color or graphics pen pixel/ bit pattern.
PaintRgn	Fills a region with the current foreground color or graphics pen pixel/ bit pattern.
FillRect	Fills a rectangle with a specified bit pattern.
FillCRect	Fills a rectangle with a specified pixel pattern.
FillOval	Fills an oval with a specified bit pattern.
FillCOval	Fills an oval with a specified pixel pattern.
FillRoundRect	Fills a round rectangle with a specified bit pattern.
FillCRoundRect	Fills a round rectangle with a specified pixel pattern.
FillArc	Fills a wedge of an oval with a specified bit pattern.
FillCArc	Fills a wedge of an oval with a specified pixel pattern.
FillPoly	Fills a polygon with a specified bit pattern.
FillCPoly	Fills a polygon with a specified pixel pattern.
FillRgn	Fills a region with a specified bit pattern.
FillCRgn	Fills a region with a specified pixel pattern.

## Wedges

The **wedges** drawn by `PaintArc`, `FillArc`, and `FillCArc` are pie-shaped segments of an oval bounded by a pair of radii joining at the oval's center. A wedge includes part of the oval's interior. Like the framed arc, wedges are defined by the bounding rectangle that encloses the oval, along with a pair of angles marking the positions of the bounding radii. Fig 7 shows a wedge.

## Painted and Filled Polygons and Regions

The general procedure for drawing painted and filled polygons and regions is the same as described for their framed counterparts, above.

Fig 7 shows the polygon as defined for the framed polygon in Fig 6, but this time drawn with one of the polygon painting or filling functions. Note that, although the final defining line from the last vertex back to the first vertex was not drawn, the painting and filling functions complete the polygon (whereas `FramePoly` did not).

Fig 7 also shows a region comprising two rectangles and an overlapping oval, drawn using `PaintRgn`. Note that, where two regions overlap, the additional area is added to the region and the overlap is removed from the region.

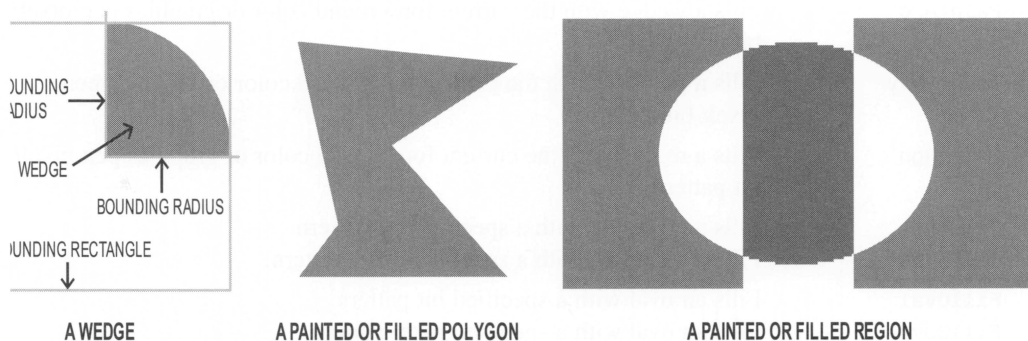


FIG 7 - A WEDGE, A PAINTED OR FILLED POLYGON, AND A PAINTED OR FILLED REGION

## Erasing and Inverting Shapes

Erasing a shape fills both its outline and its interior with the background color or background pixel/bit pattern. Inverting a shape simply inverts all the pixels in the shape; for example, all black pixels become white, and vice versa.

**Transfer Mode.** In erasing operations, the transfer mode is invariably the pattern mode `patCopy`, meaning that the destination pixels are always completely overwritten.

## Functions for Erasing and Inverting Shapes

The following list the available functions for painting and filling shapes:

<i>Function</i>	<i>Description</i>
<code>EraseRect</code>	Fills a rectangle with the current background color or pixel/ bit pattern.
<code>EraseOval</code>	Fills an oval with the current background color or pixel/ bit pattern.
<code>EraseRoundRect</code>	Fills a round rectangle with the current background color or pixel/ bit pattern.

<i>Function</i>	<i>Description</i>
EraseArc	Fills a wedge with the current background color or pixel/ bit pattern.
ErasePoly	Fills a polygon with the current background color or pixel/ bit pattern.
EraseRgn	Fills a region with the current background color or pixel/ bit pattern.
InvertRect	Inverts all the pixels in a rectangle.
InvertOval	Inverts all the pixels in an oval.
InvertRoundRect	Inverts all the pixels in a round rectangle.
InvertArc	Inverts all the pixels in a wedge.
InvertPoly	Inverts all the pixels in a polygon.
InvertRgn	Inverts all the pixels in a region.

## Drawing Pictures

Your application can record a sequence of QuickDraw drawing operations in a **picture** and play its image back later. Fig 8 shows an example of a simple picture containing a filled rectangle, a filled oval, and some text.

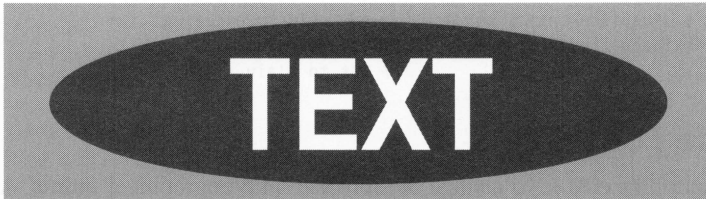


FIG 8 - A SIMPLE QUICKDRAW PICTURE

The subject of pictures is addressed in more detail in Chapter 13.

## Drawing Text

### Setting the Font

The font used to draw text in a graphics port may be set using the function `TextFont`. `TextFont` takes a single parameter, of type `SInt16`, which may be either a predefined constant or a **font family ID** number. Although predefined constants remain in the header file `Fonts.h`, their use is now discouraged by Apple.



You can get the font family ID using `GetFNum`. For example, the following sets the current font to Palatino:

```
SInt16 fontNum;  
  
GetFNum("\pPalatino",&fontNum);  
TextFont(fontNum);
```

### NOTE

If you know the font family ID, you can get its name by calling the Font Manager's `GetFontName` function. If you do not know either the font family ID or the font name, you can use the Resource Manager's `GetIndResource` function followed by the `GetResInfo` function to determine the names and IDs of all available fonts.

## Setting and Modifying the Text Style

You use the function `TextFace` to change the text style, using any combination of the constants `bold`, `italic`, `underline`, `outline`, `shadow`, `condense`, and `extend`. Some examples are as follows:

```
TextFace(bold); // Set to bold.  
TextFace(bold | italic); // Set to bold and italic.)  
TextFace(GetPortTextFace(thePort) | bold); // Add bold to existing.  
TextFace(GetPortTextFace(thePort) &~ bold); // Remove bold.  
TextFace(normal); // Set to plain.
```

## Setting the Font Size

You use the function `TextSize` to change the font size in typographical **points**. A point is approximately 1/72 inch.

## Changing the Width of Characters

Widening and narrowing space and non-space characters lets you meet special formatting requirements. You use `SpaceExtra` to specify the extra pixels to be added to or subtracted from the standard width of the space character. `SpaceExtra` is ordinarily used in text-justification functions.

## Transfer Mode

The transfer mode initially set in the graphics port is the Boolean source mode `srcOr`. This mode causes the color of the glyph to be determined by the foreground color and the drawn glyph to completely overwrite the existing pixels. (In this mode only those bits which make up the actual glyph are drawn.)

**NOTE**

A glyph is the visual representation of a character.

You should generally use either `srcOr` or `srcBic` when drawing text, because all other transfer modes draw the character's background as well as the glyph itself. This can result in the clipping of characters by adjacent characters.

## Copying Pixel Images Between Graphics Ports

QuickDraw provides the following three functions for copying pixel images between graphics ports:

- `CopyBits`, which copies a pixel image to another graphics port, optionally allowing you to
  - Resize the image
  - Modify the image with transfer modes
  - Clip the image to a region
- `CopyMask`, which copies a pixel image to another graphics port, allowing you to
  - Resize the image
  - Modify the image by passing it through a mask
- `CopyDeepMask`, which combines the effects of `CopyBits` and `CopyMask`, optionally allowing you to
  - Resize the image
  - Clip the image to a region
  - Specify a transfer mode
  - Modify the image by passing it through a mask

The mask used by `CopyMask` and `CopyDeepMask` may be another pixel map whose pixels indicate proportionate weights of the colors for the source and destination pixels.

The `CopyBits`, `CopyMask`, and `CopyDeepMask` functions date from the era of black-and-white Macintoshes, which is why they expect a pointer to a bitmap in their source and destination parameters. Thus, when you are copying pixel maps using these functions, you must cast the address of the handle to the pixel map to a pointer to a bitmap. By looking at certain information in the graphics port object, `CopyBits`, `CopyMask`, and `CopyDeepMask` can establish that you have passed the functions a handle to a pixel map rather than the base address of a bitmap.

## Using Masks

With `CopyMask` and `CopyDeepMask`, you supply a pixel map to act as the mask. The mask's pixels proportionally select between source and destination pixel values.

In the case of masks that are 1 bit deep, black bits in the mask cause the destination pixel to take the color of the source pixel and white bits cause the destination pixel to retain its current color. In the case of masks with pixel depths greater than 1, `Color QuickDraw` takes a weighted average between source and destination colors. For example, a blue mask (that is, one with high values for the blue components of all pixels) filters out blue values coming from the source.

## Transfer Modes

`CopyBits` and `CopyDeepMask` both allow you to specify the transfer mode, which can be either a Boolean source mode or an arithmetic source mode.

## The Importance of Foreground and Background Color

Applying a foreground color other than black or a background color other than white to the pixel can produce an unexpected result. For consistent results, you should set the foreground color to black and the background color to white before using `CopyBits`, `CopyMask`, or `CopyDeepMask`. (That said, setting foreground and background colors to something other than black or white can achieve some interesting coloration effects.)

## Dithering

You can use **dithering** with `CopyBits` and `CopyDeepMask`. Dithering is a technique involving the mixing of existing colors to create the illusion of a third color. This is most useful for images displayed on indexed devices, which can only display a limited number of colors at any one time.

You can add dithering to any transfer mode by adding the following constant to the transfer mode:

```
ditherCopy = 64    // Add to source mode for dithering.
```

## Copying from Offscreen Graphics Ports

To gracefully display complex images, your application should construct the image in an **off-screen graphics world** and then use `CopyBits` to transfer the image to the onscreen graphics port. (Offscreen graphics worlds are addressed in Chapter 13.)

## Scrolling Pixels in the Port Rectangle

You can use `ScrollRect` to scroll the pixels in the port rectangle. `ScrollRect` takes four parameters: the rectangle to scroll, a horizontal distance to scroll, a vertical distance to scroll, and a region reference. `ScrollRect` is a special form of `CopyBits` which copies bits enclosed by a rectangle and stores them within that same rectangle. The vacated area is filled with the current background color or pixel/bit pattern.

## Manipulating Rectangles and Regions

QuickDraw provides many functions for manipulating rectangles and regions. You can use the functions that manipulate rectangles to manipulate any shape based on a rectangle, that is, rounded rectangles, ovals, arcs, and wedges.

For example, you could define a rectangle to bound an oval and then frame the oval. You could then use `OffsetRect` to move the oval's bounding rectangle down. Using the offset bounding rectangle, you could frame a second, connected oval to form a figure eight with the first oval. You could then use that shape to help define a region. You could create a second region, and then use `UnionRgn` to create a region from the union of the two.

## Manipulating Rectangles

The following summarizes the functions for manipulating and performing calculations on rectangles:

<i>Function</i>	<i>Description</i>
<code>EmptyRect</code>	Determines whether a rectangle is an empty rectangle
<code>EqualRect</code>	Determines whether two rectangles are equal
<code>InsetRect</code>	Shrinks or expands a rectangle
<code>OffsetRect</code>	Moves a rectangle
<code>PtInRect</code>	Determines whether a pixel is enclosed in a rectangle
<code>PtToAngle</code>	Calculates the angle from the middle of a rectangle to a point
<code>Pt2Rect</code>	Determines the smallest rectangle that encloses two points
<code>SectRect</code>	Determines whether two rectangles intersect
<code>UnionRect</code>	Calculates the smallest rectangle that encloses two rectangles

## Manipulating Regions

The following summarizes the functions for manipulating, and performing calculations on, regions:

<i>Function</i>	<i>Description</i>
CopyRgn	Makes a copy of a region
DiffRgn	Subtracts one region from another
EmptyRgn	Determines whether a region is empty
EqualRgn	Determines whether two regions have identical sizes, shapes, and locations
InsetRgn	Shrinks or expands a region
OffsetRgn	Moves a region
PtInRgn	Determines whether a pixel is within a region
RectInRgn	Determines whether a rectangle intersects a region
RectRgn	Changes the structure of an existing region to that of a rectangle (using a Rect)
SectRgn	Calculates the intersection of two regions
SetEmptyRgn	Sets a region to empty
SetRectRgn	Changes the structure of an existing region to that of a rectangle (using coordinates)
UnionRgn	Calculates the union of two regions
XorRgn	Calculates the difference between the union and the intersection of two regions

## Manipulating Polygons

You can use `OffsetPoly` to move a polygon; however, QuickDraw provides no other functions for manipulating polygons.

## Scaling Shapes and Regions Within the Same Graphics Port

To scale shapes and regions within the same graphics port, you can use the functions `ScalePt`, `MapPt`, `MapRect`, `MapRgn`, and `MapPoly`.

## Highlighting

**Highlighting** is used when selecting and deselecting objects such as text or graphics. TextEdit, for example, uses highlighting to indicate selected text. If the current highlight color is, for example, blue, TextEdit draws the selected text, then uses `InvertRgn` to produce a blue background for the text.

The **system highlight color**, which can be changed by the user at the Highlight Color item in the Appearance pane of the Appearance control panel, is stored in a low memory global represented by the symbolic name `HiliteRGB`. It can be retrieved using `LMGetHiliteRGB`. You can override the default color using the function `HiliteColor`. The current color is copied to the graphics port object, and may be retrieved from there using the function `GetPortHiliteColor`.

Color QuickDraw implements highlighting by replacing the background color with the highlight color. Another low memory global, represented by the symbolic name `HiliteMode`, contains a byte that represents the current highlight mode. One bit in that byte, represented by the constant `pHiliteBit`, is used to toggle the background and highlight colors.

Because Color QuickDraw resets the highlight bit after performing each drawing operation, your application must always clear the highlight bit immediately before calling `InvertRgn` (or, indeed, any of the other drawing or image-copying function that uses the `patXor` or `srcXor` transfer modes.)

The highlight mode can be retrieved and set using `LMGetHiliteMode` and `LMSetHiliteMode`, and `BitClr` may be used to clear the highlight bit:

```
UInt8 hiliteMode;
...
hiliteMode = LMGetHiliteMode();
BitClr(&hiliteMode,pHiliteBit);
LMSetHiliteMode(hiliteMode);
```

Another way to use highlighting is to add this constant to the transfer mode you pass in calls to the functions `PenMode`, `CopyBits`, `CopyDeepMask` and `TextMode`:

```
hilite = 50 // Add to source or pattern mode for highlighting.
```

## Drawing Other Graphics Entities

In addition to drawing lines, rectangles, rounded rectangles, ovals, arcs, wedges, polygons and regions, and text, you can also use QuickDraw to draw the following:

- Cursors
- Icons

Cursors and Icons are addressed in Chapter 13.

## Saving and Restoring the Graphics Port Drawing State

As stated above, the functions `GetPenState` and `SetPenState` are used to save and restore the graphics pen's location, size, transfer mode, and pattern, and `PenNormal` is used to initialize the pen's size, transfer mode, and pattern.

Typically, an application calls `GetPenState` at the beginning of a function that changes the pen's location, size, transfer mode, and/or pattern and restores the saved state to the pen on exit from that function. Depending on its requirements, an application might also save and restore the graphics port's foreground and background colors, and the text transfer mode, in the same way.

Since the introduction of the Appearance Manager, it has also become necessary to save and restore the pen pixel/bit pattern and background pixel/bit pattern in functions that call the Appearance Manager functions `SetThemeBackground`, `SetThemePen`, and/or `SetThemeWindowBackground`. Recall from Chapter 6: The Appearance Manager that constants of type `ThemeBrush` are passed in the `inBrush` parameter of these Appearance Manager functions and that the value in the `inBrush` parameter can represent either a color or a pattern depending on the current appearance.

Accordingly, in the era of the Appearance Manager, applications that call `SetThemeBackground` and/or `SetThemePen` will need to take measures to save and restore the *complete* graphics port drawing state and, if required, normalize that state.

The following functions are used for saving, restoring, and normalizing the graphics port drawing state:

<i>Function</i>	<i>Description</i>
<code>GetThemeDrawingState</code>	Obtains the drawing state of the current graphics port.
<code>SetThemeDrawingState</code>	Sets the drawing state of the current graphics port.
<code>NormalizeThemeDrawingState</code>	Sets the current graphics port to the default drawing state.
<code>DisposeThemeDrawingState</code>	Releases the memory associated with a reference to a graphics port's drawing state. (Note that this memory may also be released by passing true in the <code>inDisposeNow</code> parameter of <code>SetThemeDrawingState</code> .)

Information about the current state of the graphics port is stored in a structure of type `ThemeDrawingState`. This is a private data structure.



# Main QuickDraw Constants, Data Types and Functions

## Constants

### Boolean Pattern Modes

patCopy = 8  
patOr = 9  
patXor = 10  
patBic = 11  
notPatCopy = 12  
notPatOr = 13  
notPatXor = 14  
notPatBic = 15

### Boolean Source Modes

srcCopy = 0  
srcOr = 1  
srcXor = 2  
srcBic = 3  
notSrcCopy = 4  
notSrcOr = 5  
notSrcXor = 6  
notSrcBic = 7

### Arithmetic Transfer Modes

blend = 32  
addPin = 33  
addOver = 34  
subPin = 35  
transparent = 36  
addMax = 37  
subOver = 38  
adMin = 39

### Add Dithering to Transfer Modes

ditherCopy = 64

### Highlighting

hilite = 50  
hiliteBit = 7  
pHiliteBit = 0

### Pattern List Resource ID for Pattern Resources in the System File

sysPatListID = 0

## Data Types

### Point

```
struct Point
{
    short    v;
    short    h;
};
```

```
typedef struct Point Point;
typedef Point *PointPtr;
```

### Rect

```
struct Rect
{
    short    top;
    short    left;
    short    bottom;
    short    right;
};
```

```
typedef struct Rect Rect;
typedef Rect *RectPtr;
```

### Region

```
typedef struct OpaqueRgnHandle *RgnHandle;
```

### Polygon

```
struct Polygon
{
    short    polySize;
    Rect     polyBBox;
    Point    polyPoints[1];
};
```

```
typedef struct Polygon Polygon;
typedef Polygon *PolyPtr, **PolyHandle;
```

### PenState

```
struct PenState
{
    Point    pnLoc;
    Point    pnSize;
    short    pnMode;
    Pattern  pnPat;
};
```

```
typedef struct PenState PenState;
```

## Functions

### Managing the Graphics Pen

```
void      HidePen(void);
void      ShowPen(void);
void      GetPen(Point *pt);
void      GetPenState(PenState *pnState);
void      SetPenState(const PenState *pnState);
void      PenSize(short width,short height);
void      PenMode(short mode);
void      PenNormal(void);
```

### Getting and Setting Foreground, Background, and Pixel Color

```
void      RGBForeColor(const RGBColor *color);
void      RGBBackColor(const RGBColor *color);
void      GetForeColor(RGBColor *color);
void      GetBackColor(RGBColor *color);
void      GetCPixel(short h,short v,RGBColor *cPix);
void      SetCPixel(short h,short v,const RGBColor *cPix);
```

### Creating and Disposing of Pixel Patterns

```
PixPatHandle  GetPixPat(short patID);
PixPatHandle  NewPixPat(void);
void          CopyPixPat(PixPatHandle srcPP,PixPatHandle dstPP);
void          MakeRGBPat(PixPatHandle pp,const RGBColor *myColor);
void          DisposePixPat(PixPatHandle pp);
```

### Getting Pattern Resources

```
PatHandle     GetPattern(short patternID);
void          GetIndPattern(Pattern *thePat,short patternListID,short index);
```

### Changing the Pen and Background Pixel Pattern and Bit Pattern

```
void          BackPixPat(PixPatHandle pp);
void          PenPixPat(PixPatHandle pp);
void          BackPat(const Pattern *pat);
void          PenPat(const Pattern *pat);
```

### Drawing Lines

```
void          MoveTo(short h,short v);
void          Move(short dh,short dv);
void          LineTo(short h,short v);
void          Line(short dh,short dv);
```

### Drawing Rectangles

```
void          FrameRect(const Rect *r);
void          PaintRect(const Rect *r);
void          FillRect(const Rect *r,ConstPatternParam pat);
void          FillCRect(const Rect *r,PixPatHandle pp);
void          InvertRect(const Rect *r);
void          EraseRect(const Rect *r);
```

### Drawing Rounded Rectangles

```
void      FrameRoundRect(const Rect *r,short ovalWidth,short ovalHeight);
void      PaintRoundRect(const Rect *r,short ovalWidth,short ovalHeight);
void      FillRoundRect(const Rect *r,short ovalWidth,short ovalHeight,const Pattern *pat);
void      FillCRoundRect(const Rect *r,short ovalWidth,short ovalHeight,PixPatHandle pp);
void      InvertRoundRect(const Rect *r,short ovalWidth,short ovalHeight);
void      EraseRoundRect(const Rect *r,short ovalWidth,short ovalHeight);
```

### Drawing Ovals

```
void      FrameOval(const Rect *r);
void      PaintOval(const Rect *r);
void      FillOval(const Rect *r,const Pattern *pat);
void      FillCOval(const Rect *r,PixPatHandle pp);
void      InvertOval(const Rect *r);
void      EraseOval(const Rect *r);
```

### Drawing Arcs and Wedges

```
void      FrameArc(const Rect *r,short startAngle,short arcAngle);
void      PaintArc(const Rect *r,short startAngle,short arcAngle);
void      FillArc(const Rect *r,short startAngle,short arcAngle,const Pattern *pat);
void      FillCArc(const Rect *r,short startAngle,short arcAngle,PixPatHandle pp);
void      InvertArc(const Rect *r,short startAngle,short arcAngle);
void      EraseArc(const Rect *r,short startAngle,short arcAngle);
```

### Drawing and Painting Polygons

```
void      FramePoly(PolyHandle poly);
void      PaintPoly(PolyHandle poly);
void      FillPoly(PolyHandle poly,const Pattern *pat);
void      FillCPoly(PolyHandle poly,PixPatHandle pp);
void      InvertPoly(PolyHandle poly);
void      ErasePoly(PolyHandle poly);
```

### Drawing Regions

```
void      FrameRgn(RgnHandle rgn);
void      PaintRgn(RgnHandle rgn);
void      FillCRgn(RgnHandle rgn,PixPatHandle pp);
void      EraseRgn(RgnHandle rgn);
void      InvertRgn(RgnHandle rgn);
void      FillRgn(RgnHandle rgn, const Pattern *pat);
```

### Setting Text Characteristics

```
void      TextFont(short font);
void      TextFace(short face);
void      TextMode(short mode);
void      TextSize(short size);
void      SpaceExtra(Fixed extra);
void      GetFontInfo(FontInfo *info);
```

### Drawing and Measuring Text

```
void      DrawChar(short ch);
void      DrawString(ConstStr255Param s);
void      DrawText(const void *textBuf,short firstByte,short byteCount);
short     CharWidth(short ch);
short     StringWidth(ConstStr255Param s);
```

## Copying Images

```
void      CopyBits(const BitMap *srcBits,const BitMap *dstBits,const Rect *srcRect,
               const Rect *dstRect,short mode,RgnHandle maskRgn);
void      CopyMask(const BitMap *srcBits,const BitMap *maskBits,const BitMap *dstBits,
               const Rect *srcRect,const Rect *maskRect,const Rect *dstRect);
void      CopyDeepMask(const BitMap *srcBits,const BitMap *maskBits,const BitMap *dstBits,
               const Rect *srcRect,const Rect *maskRect,const Rect *dstRect,short mode,
               RgnHandle maskRgn);
```

## Getting and Setting the Highlight Color and HighLight Mode

```
void      HiliteColor(const RGBColor *color);
void      LMGetHiliteRGB(RGBColor *hiliteRGBValue);
void      LMSetHiliteRGB(const RGBColor *hiliteRGBValue);
UInt8     LMGetHiliteMode(void);
void      LMSetHiliteMode(UInt8 value);
```

## Creating and Disposing of Color Tables

```
CtabHandle  GetCTable(short ctID);
void        DisposeCTable(CtabHandle cTable);
```

## Creating and Managing Polygons

```
PolyHandle  OpenPoly(void);
void        ClosePoly(void);
void        KillPoly(PolyHandle poly);
void        OffsetPoly(PolyHandle poly,short dh,short dv);
```

## Creating and Managing Rectangles

```
void        SetRect(Rect *r,short left,short top,short right,short bottom);
void        OffsetRect(Rect *r,short dh,short dv);
void        InsetRect(Rect *r,short dh,short dv);
Boolean     SectRect(const Rect *src1,const Rect *src2,Rect *dstRect);
void        UnionRect(const Rect *src1,const Rect *src2,Rect *dstRect);
Boolean     PtInRect(Point pt,const Rect *r);
void        Pt2Rect(Point pt1,Point pt2,Rect *dstRect);
void        PtToAngle(const Rect *r,Point pt,short *angle);
Boolean     EqualRect(const Rect *rect1,const Rect *rect2);
Boolean     EmptyRect(const Rect *r);
```

## Creating and Managing Regions

```
RgnHandle   NewRgn(void);
void        OpenRgn(void);
void        CloseRgn(RgnHandle dstRgn);
void        DisposeRgn(RgnHandle rgn);
void        CopyRgn(RgnHandle srcRgn,RgnHandle dstRgn);
void        SetEmptyRgn(RgnHandle rgn);
void        SetRectRgn(RgnHandle rgn,short left,short top,short right,short bottom);
void        RectRgn(RgnHandle rgn,const Rect *r);
void        OffsetRgn(RgnHandle rgn,short dh,short dv);
void        InsetRgn(RgnHandle rgn,short dh,short dv);
void        SectRgn(RgnHandle srcRgnA,RgnHandle srcRgnB,RgnHandle dstRgn);
void        UnionRgn(RgnHandle srcRgnA,RgnHandle srcRgnB,RgnHandle dstRgn);
void        DiffRgn(RgnHandle srcRgnA,RgnHandle srcRgnB,RgnHandle dstRgn);
void        XorRgn(RgnHandle srcRgnA,RgnHandle srcRgnB,RgnHandle dstRgn);
```

```

Boolean    PtInRgn(Point pt,RgnHandle rgn);
Boolean    RectInRgn(const Rect *r,RgnHandle rgn);
Boolean    EqualRgn(RgnHandle rgnA,RgnHandle rgnB);
Boolean    EmptyRgn(RgnHandle rgn);
OSErr      BitMapToRegion(RgnHandle region,const BitMap *bMap);

```

### Scaling and Mapping Points, Rectangles, Polygons, and Regions

```

void        ScalePt(Point *pt,const Rect *srcRect,const Rect *dstRect);
void        MapPt(Point *pt,const Rect *srcRect,const Rect *dstRect);
void        MapRect(Rect *r,const Rect *srcRect,const Rect *dstRect);
void        MapRgn(RgnHandle rgn,const Rect *srcRect,const Rect *dstRect);
void        MapPoly(PolyHandle poly,const Rect *srcRect,const Rect *dstRect);

```

### Determining Whether QuickDraw Has Finished Drawing

```

Boolean     QDDone(GrafPtr port);

```

### Retrieving Color QuickDraw Result Codes

```

short       QDError(void);

```

### Managing Port Rectangles and Clipping Regions

```

void        ScrollRect(const Rect *r,short dh,short dv,RgnHandle updateRgn);
void        SetOrigin(short h,short v);
void        PortSize(short width,short height);
void        MovePortTo(short leftGlobal,short topGlobal);
void        GetClip(RgnHandle rgn);
void        SetClip(RgnHandle rgn);
void        ClipRect(const Rect *r);

```

### Manipulating Points in Graphics Ports

```

void        GlobalToLocal(Point *pt);
void        LocalToGlobal(Point *pt);
void        AddPt(Point src,Point *dst);
void        SubPt(Point *src,Point *dst);
void        SetPt(Point *pt,short h,short v);
Boolean     EqualPt(Point pt1,Point pt2);
Boolean     GetPixel(short h,short v);

```

## Relevant Appearance Manager Data Types and Functions

### Data Types

```

typedef struct OpaqueThemeDrawingState *ThemeDrawingState;

```

### Functions

```

OSStatus    NormalizeThemeDrawingState(void);
OSStatus    GetThemeDrawingState(ThemeDrawingState *outState);
OSStatus    SetThemeDrawingState(ThemeDrawingState inState,Boolean inDisposeNow);
OSStatus    DisposeThemeDrawingState(ThemeDrawingState inState);

```

## Demonstration Program QuickDraw Listing

```
// *****
// QuickDraw.c                                CLASSIC EVENT MODEL
// *****
//
// This program opens a window in which the results of various QuickDraw drawing operations
// are displayed. Individual line and text drawing, framing, painting, filling, erasing,
// inverting, copying, etc., operations are chosen from a Demonstration pull-down menu.
//
// To keep the non-QuickDraw code to a minimum, the program contains no functions for
// updating the window or for responding to activate and operating system events.
//
// The program utilises the following resources:
//
// • A 'plst' resource.
//
// • 'WIND' resources for the main window, and a small window used for the CopyBits
//   demonstration (purgeable) (initially visible).
//
// • An 'MBAR' resource and associated 'MENU' resources (preload, non-purgeable).
//
// • Two 'ICON' resources (purgeable) used for the boolean source modes demonstration.
//
// • Two 'PICT' resources (purgeable) used in the arithmetic source modes demonstration.
//
// • 'STR#' resources (purgeable) containing strings used in the source modes and text
//   drawing demonstrations.
//
// • Three 'ppat' resources (purgeable), two of which are used in various drawing,
//   framing, painting, filling, and erasing demonstrations. The third is used in the
//   drawing with mouse demonstration.
//
// • A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenubar          128
#define mAppleApplication 128
#define iAbout            1
#define mFile             129
#define iQuit             12
#define mDemonstration    131
#define iLine             1
#define iFrameAndPaint    2
#define iFillEraseInvert  3
#define iPolygonRegion     4
```



```

#define iText                5
#define iScrolling           6
#define iBooleanSourceModes  7
#define iArithmeticSourceModes 8
#define iHighlighting        9
#define iDrawWithMouse       10
#define iDrawingState        11
#define rWindow              128
#define rPixelPattern1       128
#define rPixelPattern2       129
#define rPixelPattern3       130
#define rDestinationIcon     128
#define rSourceIcon          129
#define rFontsStringList     128
#define rBooleanStringList   129
#define rArithmeticStringList 130
#define rPicture              128
#define MAX_UINT32            0xFFFFFFFF

// ..... global variables

Boolean  gRunningOnX    = false;
Boolean  gDone;
WindowRef gWindowRef;
Boolean  gDrawWithMouseActivated;
SInt16   gPixelDepth;
Boolean  gIsColorDevice = false;
RGBColor gWhiteColor    = { 0xFFFF, 0xFFFF, 0xFFFF };
RGBColor gBlackColor    = { 0x0000, 0x0000, 0x0000 };
RGBColor gRedColor      = { 0xAAAA, 0x0000, 0x0000 };
RGBColor gYellowColor   = { 0xFFFF, 0xCCCC, 0x0000 };
RGBColor gGreenColor    = { 0x0000, 0x9999, 0x0000 };
RGBColor gBlueColor     = { 0x6666, 0x6666, 0x9999 };

// ..... function prototypes

void  main                (void);
void  doPreliminaries     (void);
OSErr  quitAppEventHandler (AppleEvent *,AppleEvent *,SInt32);
void  doEvents             (EventRecord *);
void  doDemonstrationMenu (MenuItemIndex);
void  doLines              (void);
void  doFrameAndPaint      (void);
void  doFillEraseInvert   (void);
void  doPolygonAndRegion   (void);
void  doScrolling          (void);
void  doText               (void);
void  doBooleanSourceModes (void);
void  doArithmeticSourceModes (void);
void  doHighlighting       (void);
void  doDrawWithMouse      (void);
void  doDrawingState       (void);
void  doDrawingStateProof  (SInt16);
void  doGetDepthAndDevice  (void);
UInt16 doRandomNumber      (UInt16,UInt16);

```

```
// ***** main

void main(void)
{
    UInt32      seconds;
    MenuBarHandle menubarHdl;
    SInt32      response;
    MenuRef     menuRef;
    EventRecord  eventStructure;
    Boolean     gotEvent;

    // ..... do preliminaries

    doPreliminaries();

    // ..... seed random number generator

    GetDateTime(&seconds);
    SetQDGlobalsRandomSeed(seconds);

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMenubar);
    if(menubarHdl == NULL)
        ExitToShell();
    SetMenuBar(menubarHdl);
    DrawMenuBar();

    Gestalt(gestaltMenuMgrAttr,&response);
    if(response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
        {
            DeleteMenuItem(menuRef,iQuit);
            DeleteMenuItem(menuRef,iQuit - 1);
            DisableMenuItem(menuRef,0);
        }

        gRunningOnX = true;
    }

    // ..... open window

    if(!(gWindowRef = GetNewCWindow(rWindow,NULL,(WindowRef)-1)))
        ExitToShell();

    SetPortWindowPort(gWindowRef);
    UseThemeFont(kThemeSmallSystemFont,smSystemScript);

    // ..... get pixel depth and whether color device for certain Appearance Manager functions

    doGetDepthAndDevice();
}
```

```

// ..... eventLoop

gDone = false;

while(!gDone)
{
    gotEvent = WaitNextEvent(everyEvent,&eventStructure,MAX_UINT32,NULL);
    if(gotEvent)
        doEvents(&eventStructure);
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    OSErr osError;

    MoreMasterPointers(32);
    InitCursor();
    FlushEvents(everyEvent,0);

    osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
                                   NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
                                   0L,false);

    if(osError != noErr)
        ExitToShell();
}

// ***** doQuitAppEvent

OSErr quitAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,SInt32 handlerRefcon)
{
    OSErr osError;
    DescType returnedType;
    Size actualSize;

    osError = AEGetAttributePtr(appEvent,keyMissedKeywordAttr,typeWildCard,&returnedType,NULL,0,
                                &actualSize);

    if(osError == errAEDescNotFound)
    {
        gDone = true;
        osError = noErr;
    }
    else if(osError == noErr)
        osError = errAEParamMissed;

    return osError;
}

```

```
// ***** doEvents
```

```
void doEvents(EventRecord *eventStrucPtr)
{
    SInt32      menuChoice;
    MenuID      menuID;
    MenuItemIndex menuItem;
    WindowPartCode partCode;
    WindowRef    windowRef;

    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEResponseAppleEvent(eventStrucPtr);
            break;

        case keyDown:
            if((eventStrucPtr->modifiers & cmdKey) != 0)
            {
                menuChoice = MenuEvent(eventStrucPtr);
                menuID = HiWord(menuChoice);
                menuItem = LoWord(menuChoice);
                if(menuID == mFile && menuItem == iQuit)
                    gDone = true;
            }
            break;

        case mouseDown:
            if(partCode = FindWindow(eventStrucPtr->where,&windowRef))
            {
                switch(partCode)
                {
                    case inMenuBar:
                        menuChoice = MenuSelect(eventStrucPtr->where);
                        menuID = HiWord(menuChoice);
                        menuItem = LoWord(menuChoice);

                        if(menuID == 0)
                            return;

                        switch(menuID)
                        {
                            case mAppleApplication:
                                if(menuItem == iAbout)
                                    SysBeep(10);
                                break;

                            case mFile:
                                if(menuItem == iQuit)
                                    gDone = true;
                                break;

```

```

        case mDemonstration:
            doDemonstrationMenu(menuItem);
            break;
    }
    break;

case inDrag:
    DragWindow(windowRef, eventStrucPtr->where, NULL);
    break;

case inContent:
    if(windowRef != FrontWindow())
        SelectWindow(windowRef);
    else
        if(gDrawWithMouseActivated)
            doDrawWithMouse();
    break;
}
}
break;

case updateEvt:
    windowRef = (WindowRef) eventStrucPtr->message;
    BeginUpdate(windowRef);
    EndUpdate(windowRef);
    break;
}
}

// ***** doDemonstrationMenu

void doDemonstrationMenu(MenuBarItem menuBarItem)
{
    Rect portRect;
    Pattern whitePattern;

    gDrawWithMouseActivated = false;

    switch(menuBarItem)
    {
        case iLine:
            doLines();
            break;

        case iFrameAndPaint:
            doFrameAndPaint();
            break;

        case iFillEraseInvert:
            doFillEraseInvert();
            break;

        case iPolygonRegion:
            doPolygonAndRegion();
            break;
    }
}

```

```

case iText:
    doText();
    break;

case iScrolling:
    doScrolling();
    break;

case iBooleanSourceModes:
    doBooleanSourceModes();
    break;

case iArithmeticSourceModes:
    doArithmeticSourceModes();
    break;

case iHighlighting:
    doHighlighting();
    break;

case iDrawWithMouse:
    SetWTitle(gWindowRef, "\pDrawing with the mouse");
    RGBBackColor(&gWhiteColor);
    GetWindowPortBounds(gWindowRef, &portRect);
    FillRect(&portRect, GetQDGlobalsWhite(&whitePattern));
    gDrawWithMouseActivated = true;
    break;

case iDrawingState:
    doDrawingState();
    break;
}

HiliteMenu(0);
}

// ***** doLines
void doLines(void)
{
    Rect        portRect, newClipRect;
    Pattern      whitePattern, systemPattern, blackPattern;
    RgnHandle    oldClipRgn;
    SInt16       a, b, c;
    RGBColor     theColor;
    UInt32       finalTicks;
    PixPatHandle pixpatHdl;

    PenNormal();

    RGBBackColor(&gBlueColor);
    GetWindowPortBounds(gWindowRef, &portRect);
    FillRect(&portRect, GetQDGlobalsWhite(&whitePattern));

```

```

newClipRect = portRect;
InsetRect(&newClipRect,10,10);
oldClipRgn = NewRgn();
GetClip(oldClipRgn);
ClipRect(&newClipRect);

// ..... lines drawn with foreground color and black pen pattern

SetWTitle(gWindowRef,"\\pDrawing lines with colors");
RGBBackColor(&gWhiteColor);
FillRect(&portRect,&whitePattern);

if(!gRunningOnX)
    SetThemeCursor(kThemeWatchCursor);

for(a=1;a<60;a++)
{
    b = doRandomNumber(0,portRect.right - portRect.left);
    c = doRandomNumber(0,portRect.right - portRect.left);

    theColor.red   = doRandomNumber(0,65535);
    theColor.green = doRandomNumber(0,65535);
    theColor.blue  = doRandomNumber(0,65535);
    RGBForeColor(&theColor);

    PenSize(a * 2,1);

    MoveTo(b,portRect.top);
    LineTo(c,portRect.bottom);

    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
    Delay(2,&finalTicks);
}

if(!gRunningOnX)
    SetThemeCursor(kThemeArrowCursor);

// ..... lines drawn with system-supplied bit patterns

SetWTitle(gWindowRef,"\\pClick mouse for more lines");
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
while(!Button()) ;
SetWTitle(gWindowRef,"\\pDrawing lines with system-supplied bit patterns");
FillRect(&portRect,&whitePattern);

if(!gRunningOnX)
    SetThemeCursor(kThemeWatchCursor);

for(a=1;a<39;a++)
{
    b = doRandomNumber(0,portRect.bottom - portRect.top);
    c = doRandomNumber(0,portRect.bottom - portRect.top);

```



```

theColor.red   = doRandomNumber(0,32767);
theColor.green = doRandomNumber(0,32767);
theColor.blue  = doRandomNumber(0,32767);
RGBForeColor(&theColor);

GetIndPattern(&systemPattern,sysPatListID,a);
PenPat(&systemPattern);

PenSize(1, a * 2);

MoveTo(portRect.left,b);
LineTo(portRect.right,c);

QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(5,&finalTicks);
}

if(!gRunningOnX)
    SetThemeCursor(kThemeArrowCursor);

// ..... lines drawn with a pixel pattern

SetWTitle(gWindowRef,"pClick mouse for more lines");
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
while(!Button() );
SetWTitle(gWindowRef,"pDrawing lines with a pixel pattern");
FillRect(&portRect,&whitePattern);

if(!gRunningOnX)
    SetThemeCursor(kThemeWatchCursor);

if(!(pixpatHdl = GetPixPat(rPixelPattern1)))
    ExitToShell();
PenPixPat(pixpatHdl);

for(a=1;a<60;a++)
{
    b = doRandomNumber(0,portRect.right - portRect.left);
    c = doRandomNumber(0,portRect.right - portRect.left);

    PenSize(a * 2,1);

    MoveTo(b,portRect.top);
    LineTo(c,portRect.bottom);

    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
    Delay(5,&finalTicks);
}

DisposePixPat(pixpatHdl);

SetClip(oldClipRgn);
DisposeRgn(oldClipRgn);

```

```

    if(!gRunningOnX)
        SetThemeCursor(kThemeArrowCursor);

    // ..... lines drawn with pattern mode patXor

    SetWTitle(gWindowRef, "\pClick mouse for more lines");
    QDFlushPortBuffer(GetWindowPort(FrontWindow()), NULL);
    while(!Button()) ;
    SetWTitle(gWindowRef, "\pDrawing lines using pattern mode patXor");

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    RGBBackColor(&gRedColor);
    FillRect(&portRect, &whitePattern);

    PenSize(1, 1);
    PenPat(GetQDGlobalsBlack(&blackPattern));
    PenMode(patXor);

    InsetRect(&portRect, 10, 10);

    for(a = portRect.left, b = portRect.right; a < portRect.right + 1; a++, b--)
    {
        MoveTo(a, portRect.top);
        LineTo(b, portRect.bottom);

        QDFlushPortBuffer(GetWindowPort(FrontWindow()), NULL);
    }

    for(a = portRect.bottom, b = portRect.top; b < portRect.bottom + 1; a--, b++)
    {
        MoveTo(portRect.left, a);
        LineTo(portRect.right, b);

        QDFlushPortBuffer(GetWindowPort(FrontWindow()), NULL);
    }

    if(!gRunningOnX)
        SetThemeCursor(kThemeArrowCursor);
}

// ***** doFrameAndPaint

void doFrameAndPaint(void)
{
    SInt16      a;
    Rect        portRect, theRect;
    Pattern      whitePattern;
    UInt32      finalTicks;
    Pattern      systemPattern;
    PixPatHandle pixpatHdl;

```

```

PenNormal();
PenSize(30,20);

for(a=0;a<3;a++)
{
    RGBBackColor(&gWhiteColor);
    GetWindowPortBounds(gWindowRef,&portRect);
    FillRect(&portRect,GetQDGlobalsWhite(&whitePattern));

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    // ..... preparation

    if(a == 0)
    {
        SetWTitle(gWindowRef,"\\pFraming and painting with a color");
        RGBForeColor(&gRedColor);                // set foreground color to red
    }
    else if(a == 1)
    {
        SetWTitle(gWindowRef,"\\pFraming and painting with a bit pattern");

        RGBForeColor(&gBlueColor);                // set foreground color to blue
        RGBBackColor(&gYellowColor);            // set foreground color to yellow
        GetIndPattern(&systemPattern,sysPatListID,16);    // get bit pattern for pen
        PenPat(&systemPattern);                    // set pen bit pattern
    }
    else if (a == 2)
    {
        SetWTitle(gWindowRef,"\\pFraming and painting with a pixel pattern");

        if(!(pixpatHdl = GetPixPat(rPixelFormat1)))        // get pixel pattern for pen
            ExitToShell();
        PenPixPat(pixpatHdl);                            // set pen pixel pattern
    }

    // ..... framing and painting

    SetRect(&theRect,30,32,151,191);
    FrameRect(&theRect);                                // FrameRect
    MoveTo(30,29);
    DrawString("\\pFrameRect");
    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
    Delay(30,&finalTicks);

    OffsetRect(&theRect,140,0);
    FrameRoundRect(&theRect,30,50);                    // FrameRoundRect
    MoveTo(170,29);
    DrawString("\\pFrameRoundRect");
    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
    Delay(30,&finalTicks);
}

```

```

OffsetRect(&theRect, 140, 0);
FrameOval(&theRect); // FrameOval
MoveTo(310, 29);
DrawString("\pFrameOval");
QDFlushPortBuffer(GetWindowPort(FrontWindow()), NULL);
Delay(30, &finalTicks);

OffsetRect(&theRect, 140, 0);
FrameArc(&theRect, 330, 300); // FrameArc
MoveTo(450, 29);
DrawString("\pFrameArc");
QDFlushPortBuffer(GetWindowPort(FrontWindow()), NULL);
Delay(30, &finalTicks);

OffsetRect(&theRect, -420, 186);
PaintRect(&theRect); // PaintRect
MoveTo(30, 214);
DrawString("\pPaintRect");
QDFlushPortBuffer(GetWindowPort(FrontWindow()), NULL);
Delay(30, &finalTicks);

OffsetRect(&theRect, 140, 0);
PaintRoundRect(&theRect, 30, 50); // PaintRoundRect
MoveTo(170, 214);
DrawString("\pPaintRoundRect");
QDFlushPortBuffer(GetWindowPort(FrontWindow()), NULL);
Delay(30, &finalTicks);

OffsetRect(&theRect, 140, 0);
PaintOval(&theRect); // PaintOval
MoveTo(310, 214);
DrawString("\pPaintOval");
QDFlushPortBuffer(GetWindowPort(FrontWindow()), NULL);
Delay(30, &finalTicks);

OffsetRect(&theRect, 140, 0);
PaintArc(&theRect, 330, 300); // PaintArc
MoveTo(450, 214);
DrawString("\pPaintArc");
QDFlushPortBuffer(GetWindowPort(FrontWindow()), NULL);
Delay(30, &finalTicks);

if (!gRunningOnX)
    SetThemeCursor(kThemeArrowCursor);

if (a < 2)
{
    SetWTitle(gWindowRef, "\pClick mouse for more");
    QDFlushPortBuffer(GetWindowPort(FrontWindow()), NULL);
    while (!Button());
}
}

```

```

DisposePixPat(pixpatHdl);
}

// ***** doFillEraseInvert

void doFillEraseInvert(void)
{
    SInt16      a;
    Rect        portRect, theRect;
    Pattern      whitePattern, fillPat, backPat;
    PixPatHandle fillPixpatHdl, backPixpatHdl;
    UInt32       finalTicks;

    PenNormal();
    PenSize(30,20);

    for(a=0;a<4;a++)
    {
        if(a < 3)
        {
            RGBBackColor(&gWhiteColor);
            GetWindowPortBounds(gWindowRef,&portRect);
            FillRect(&portRect,GetQDGlobalsWhite(&whitePattern));
        }

        if(!gRunningOnX)
            SetThemeCursor(kThemeWatchCursor);

        // ..... preparation

        if(a == 0)
        {
            SetWTitle(gWindowRef,"pFilling and erasing with colors");

            RGBForeColor(&gBlueColor);           // set blue color for foreground
            RGBBackColor(&gRedColor);             // set red color for background
            GetIndPattern(&fillPat,sysPatListID,1); // get black bit pattern for fill functions
            BackPat(&whitePattern);               // set white bit pattern for background
        }
        else if(a == 1)
        {
            SetWTitle(gWindowRef,"pFilling and erasing with bit patterns");

            RGBForeColor(&gBlueColor);           // set blue color for foreground
            RGBBackColor(&gYellowColor);         // set yellow color for background
            GetIndPattern(&fillPat,sysPatListID,37); // get bit pattern for fill functions
            GetIndPattern(&backPat,sysPatListID,19); // get bit pattern for background
            BackPat(&backPat);                   // set bit pattern for background
        }
        else if (a == 2)
        {
            SetWTitle(gWindowRef,"pFilling and erasing with pixel patterns");

```

```

        if(!fillPixpatHdl = GetPixPat(rPixelPattern1))        // get pixel patt - fill functions
            ExitToShell();
        if(!backPixpatHdl = GetPixPat(rPixelPattern2))        // get pixel pattern - background
            ExitToShell();
        BackPixPat(backPixpatHdl);                            // set pixel pattern - background
    }
    else if(a == 3)
    {
        SetWTitle(gWindowRef,"\\pInverting");

        BackPat(&whitePattern);
        SetRect(&theRect,30,15,570,29);
        EraseRect(&theRect);
        SetRect(&theRect,30,200,570,214);
        EraseRect(&theRect);
    }

    // ..... filling, erasing, and inverting

    SetRect(&theRect,30,32,151,191);
    MoveTo(30,29);
    if(a < 2)
    {
        FillRect(&theRect,&fillPat);                            // FillRect
        DrawString("\\pFillRect");
    }
    else if(a == 2)
    {
        FillCRect(&theRect,fillPixpatHdl);                    // FillCRect
        DrawString("\\pFillRect");
    }
    else if(a == 3)
    {
        InvertRect(&theRect);                                // InvertRect
        DrawString("\\pInvertRect");
    }
    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
    Delay(30,&finalTicks);

    OffsetRect(&theRect,140,0);
    MoveTo(170,29);
    if(a < 2)
    {
        FillRoundRect(&theRect,30,50,&fillPat);                // FillRoundRect
        DrawString("\\pFillRoundRect");
    }
    else if(a == 2)
    {
        FillCRoundRect(&theRect,30,50,fillPixpatHdl);          // FillCRoundRect
        DrawString("\\pFillCRoundRect");
    }
    else if(a == 3)

```

```

{
    InvertRoundRect(&theRect,30,50);           // InvertRoundRect
    DrawString("\pInvertRoundRect");
}
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

OffsetRect(&theRect,140,0);
MoveTo(310,29);
if(a < 2)
{
    FillOval(&theRect,&fillPat);                // FillOval
    DrawString("\pFillOval");
}
else if(a == 2)
{
    FillCOval(&theRect,fillPixpatHdl);          // FillCOval
    DrawString("\pFillCOval");
}
else if(a == 3)
{
    InvertOval(&theRect);                       // InvertOval
    DrawString("\pInvertOval");
}
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

OffsetRect(&theRect,140,0);
MoveTo(450,29);
if(a < 2)
{
    FillArc(&theRect,330,300,&fillPat);          // FillArc
    DrawString("\pFillArc");
}
else if(a == 2)
{
    FillCArc(&theRect,330,300,fillPixpatHdl);    // FillCArc
    DrawString("\pFillCArc");
}
else if(a == 3)
{
    InvertArc(&theRect,330,300);                 // InvertArc
    DrawString("\pInvertArc");
}
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

OffsetRect(&theRect, -420,186);
MoveTo(30,214);
if(a < 3)
{
    EraseRect(&theRect);                        // EraseRect
    DrawString("\pEraseRect");
}
else

```



```

{
    InvertRect(&theRect);
    DrawString("\pInvertRect");
}
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

OffsetRect(&theRect,140,0);
MoveTo(170,214);
if(a < 3)
{
    EraseRoundRect(&theRect,30,50);
    DrawString("\pEraseRoundRect");
}
else
{
    InvertRoundRect(&theRect,30,50);
    DrawString("\pInvertRoundRect");
}
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

OffsetRect(&theRect,140,0);
MoveTo(310,214);
if(a < 3)
{
    EraseOval(&theRect);
    DrawString("\pEraseOval");
}
else
{
    InvertOval(&theRect);
    DrawString("\pInvertOval");
}
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

OffsetRect(&theRect,140,0);
MoveTo(450,214);
if(a < 3)
{
    EraseArc(&theRect,330,300);
    DrawString("\pEraseArc");
}
else
{
    InvertArc(&theRect,330,300);
    DrawString("\pInvertArc");
}
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

if(!gRunningOnX)
    SetThemeCursor(kThemeArrowCursor);

```

```

    if(a < 3)
    {
        SetWTitle(gWindowRef, "\pClick mouse for more");
        QDFlushPortBuffer(GetWindowPort(FrontWindow()), NULL);
        while(!Button()) ;
    }
}

DisposePixPat(fillPixpatHdl);
DisposePixPat(backPixpatHdl);
}

// ***** doPolygonAndRegion

void doPolygonAndRegion(void)
{
    Rect        portRect, theRect;
    Pattern      whitePattern, backPat;
    PixPatHandle fillPixpatHdl;
    PolyHandle   polygonHdl;
    RgnHandle    regionHdl;
    UInt32       finalTicks;

    SetWTitle(gWindowRef, "\pFraming, painting, filling, and erasing polygons and regions");

    RGBBackColor(&gWhiteColor);
    GetWindowPortBounds(gWindowRef, &portRect);
    FillRect(&portRect, GetQDGlobalsWhite(&whitePattern));

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    // ..... preparation

    GetIndPattern(&backPat, sysPatListID, 17);           // get bit pattern for background
    BackPat(&backPat);                                   // set bit pattern for background
    if(!(fillPixpatHdl = GetPixPat(rPixelPattern2)))     // get pixel pattern for fill functions
        ExitToShell();
    RGBForeColor(&gRedColor);                             // set red color for foreground
    RGBBackColor(&gYellowColor);                         // set yellow color for background
    PenNormal();

    polygonHdl = OpenPoly();                             // define polygon
    MoveTo(30, 32);
    LineTo(151, 32);
    LineTo(96, 103);
    LineTo(151, 134);
    LineTo(151, 191);
    LineTo(30, 191);
    LineTo(66, 75);
    ClosePoly();

```

```

regionHdl = NewRgn();                                // define region
OpenRgn();
SetRect(&theRect,30,218,151,279);
FrameRect(&theRect);
SetRect(&theRect,30,316,151,377);
FrameRect(&theRect);
SetRect(&theRect,39,248,142,341);
FrameOval(&theRect);
CloseRgn(regionHdl);

// ..... framing, painting, filling, and erasing

FramePoly(polygonHdl);                                // FramePoly
MoveTo(30,29);
DrawString("\pFramePoly (color)");
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

OffsetPoly(polygonHdl,140,0);
PaintPoly(polygonHdl);                                // PaintPoly
MoveTo(170,29);
DrawString("\pPaintPoly (color)");
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

OffsetPoly(polygonHdl,140,0);
FillCPoly(polygonHdl,fillPixpatHdl);                  // FillCPoly
MoveTo(310,29);
DrawString("\pFillCPoly (pixel pattern)");
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

OffsetPoly(polygonHdl,140,0);
ErasePoly(polygonHdl);                                // ErasePoly
MoveTo(450,29);
DrawString("\pErasePoly (bit pattern)");
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

FrameRgn(regionHdl);                                // FrameRgn
MoveTo(30,214);
DrawString("\pFrameRgn (color)");
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

OffsetRgn(regionHdl,140,0);
PaintRgn(regionHdl);                                // PaintRgn
MoveTo(170,214);
DrawString("\pPaintRgn (color)");
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

OffsetRgn(regionHdl,140,0);

```

```

FillCRgn(regionHdl,fillPixpatHdl); // FillCRgn
MoveTo(310,214);
DrawString("\pFillCRgn (pixel pattern)");
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

OffsetRgn(regionHdl,140,0);
EraseRgn(regionHdl); // EraseRgn
MoveTo(450,214);
DrawString("\pEraseRgn (bit pattern)");
QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
Delay(30,&finalTicks);

KillPoly(polygonHdl);
DisposeRgn(regionHdl);
DisposePixPat(fillPixpatHdl);
BackPat(&whitePattern);

if(!gRunningOnX)
    SetThemeCursor(kThemeArrowCursor);
}

// ***** doText

void doText(void)
{
    Rect    portRect, theRect;
    Pattern whitePattern;
    SInt16  windowCenter, a, fontNum, stringWidth;
    Str255  textString;
    UInt32  finalTicks;

    RGBBackColor(&gWhiteColor);
    GetWindowPortBounds(gWindowRef,&portRect);
    FillRect(&portRect,GetQDGlobalsWhite(&whitePattern));

    SetWTitle(gWindowRef,"\pDrawing text with default source mode (srcOr)");

    windowCenter = (portRect.right - portRect.left) / 2;
    SetRect(&theRect,windowCenter,portRect.top,portRect.right,portRect.bottom);
    RGBBackColor(&gBlueColor);
    FillRect(&theRect,&whitePattern);

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    for(a=1;a<9;a++)
    {
        // ..... set various text fonts, text styles, and foreground colors

        if(a == 1)
        {
            GetFNum("\pGeneva",&fontNum);
            TextFont(fontNum);

```

```

        TextFace(normal);
        RGBForeColor(&gRedColor);
    }
    else if(a == 2)
        TextFace(bold);
    else if(a == 3)
    {
        GetFNum("\pTimes",&fontNum);
        TextFont(fontNum);
        TextFace(italic);
        RGBForeColor(&gYellowColor);
    }
    else if(a == 4)
        TextFace(underline);
    else if(a == 5)
    {
        GetFNum("\pHelvetica",&fontNum);
        TextFont(fontNum);
        TextFace(normal);
        RGBForeColor(&gGreenColor);
    }
    else if(a == 6)
        TextFace(bold + italic);
    else if(a == 7)
    {
        GetFNum("\pCharcoal",&fontNum);
        TextFont(fontNum);
        TextFace(condense);
        RGBForeColor(&gBlackColor);
    }
    else if(a == 8)
    {
        TextFace(extend);
    }

    // ..... set text size

    if(a < 7)
        TextSize(a * 2 + 15);
    else
        TextSize(12);

    // ..... get a string and draw it in the set font, style, size, and foreground color

    GetIndString(textString,rFontsStringList,a);
    stringWidth = StringWidth(textString);
    MoveTo(windowCenter - (stringWidth / 2),a * 46 - 10);
    DrawString(textString);

    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
    Delay(30,&finalTicks);
}

```

```
// ..... reset to Geneva 10pt normal

GetFNum("\pGeneva",&fontNum);
TextFont(fontNum);
TextSize(10);
TextFace(normal);

// ..... erase a rectangle, get a string, and use TETextBox to draw it left justified

SetRect(&theRect,portRect.left + 5,portRect.bottom - 55,portRect.left + 118,
        portRect.bottom - 5);
EraseRect(&theRect);
InsetRect(&theRect,5,5);
GetIndString(textString,rFontsStringList,9);
RGBForeColor(&gWhiteColor);
TETextBox(&textString[1],textString[0],&theRect,teFlushLeft);

if(!gRunningOnX)
    SetThemeCursor(kThemeArrowCursor);
}

// ***** doScrolling

void doScrolling(void)
{
    Rect        portRect, theRect;
    Pattern     whitePattern;
    PixPatHandle pixpat1Hdl, pixpat2Hdl;
    RgnHandle    oldClipHdl, regionAHdl, regionBHdl, regionCHdl, scrollRegionHdl;
    SInt16       a;
    UInt32       finalTicks;

    SetWTitle(gWindowRef,"\pScrolling pixels");

    RGBBackColor(&gWhiteColor);
    GetWindowPortBounds(gWindowRef,&portRect);
    FillRect(&portRect,GetQDGlobalsWhite(&whitePattern));

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    if(!(pixpat1Hdl = GetPixPat(rPixelFormat1)))
        ExitToShell();
    PenPixPat(pixpat1Hdl);
    PenSize(50,0);
    SetRect(&theRect,30,30,286,371);
    FrameRect(&theRect);
    SetRect(&theRect,315,30,571,371);
    FillCRect(&theRect,pixpat1Hdl);

    if(!(pixpat2Hdl = GetPixPat(rPixelFormat2)))
        ExitToShell();
    BackPixPat(pixpat2Hdl);

```

```

regionAHdl = NewRgn();
regionBHdl = NewRgn();
regionCHdl = NewRgn();
SetRect(&theRect,80,30,236,371);
RectRgn(regionAHdl,&theRect);
SetRect(&theRect,315,30,571,371);
RectRgn(regionBHdl,&theRect);
UnionRgn(regionAHdl,regionBHdl,regionCHdl);

oldClipHdl = NewRgn();
GetClip(oldClipHdl);
SetClip(regionCHdl);

SetRect(&theRect,80,30,571,371);

scrollRegionHdl = NewRgn();

for(a=0;a<371;a++)
{
    ScrollRect(&theRect,0,1,scrollRegionHdl);
    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
    theRect.top ++;
    Delay(1,&finalTicks);
}

SetRect(&theRect,80,30,571,371);
BackPixPat(pixpat1Hdl);

for(a=0;a<371;a++)
{
    ScrollRect(&theRect,0,-1,scrollRegionHdl);
    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
    theRect.bottom --;
    Delay(1,&finalTicks);
}

SetClip(oldClipHdl);

DisposePixPat(pixpat1Hdl);
DisposePixPat(pixpat2Hdl);
DisposeRgn(oldClipHdl);
DisposeRgn(regionAHdl);
DisposeRgn(regionBHdl);
DisposeRgn(regionCHdl);
DisposeRgn(scrollRegionHdl);

if(!gRunningOnX)
    SetThemeCursor(kThemeArrowCursor);
}

```



```
// ***** doBooleanSourceModes
```

```
void doBooleanSourceModes(void)
{
    Rect        portRect, theRect;
    Pattern      whitePattern;
    Handle       destIconHdl, sourceIconHdl;
    SInt16       a, b;
    UInt32       finalTicks;
    BitMap       sourceIconMap;
    Str255       sourceString;
    PixMapHandle destinationPixMapHdl;

    SetWTitle(gWindowRef, "\pBoolean source modes");

    RGBForeColor(&gBlackColor);
    RGBBackColor(&gGreenColor);
    GetWindowPortBounds(gWindowRef, &portRect);
    FillRect(&portRect, GetQDGlobalsWhite(&whitePattern));
    SetRect(&theRect, portRect.left, portRect.top, portRect.right,
            (portRect.bottom - portRect.top) / 2);
    RGBBackColor(&gWhiteColor);
    FillRect(&theRect, &whitePattern);

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    destIconHdl = GetIcon(rDestinationIcon);
    sourceIconHdl = GetIcon(rSourceIcon);

    for(a=0; a<2; a++)
    {
        if(a == 1)
        {
            RGBForeColor(&gYellowColor);
            RGBBackColor(&gRedColor);
        }

        SetRect(&theRect, 235, a * 191 + 30, 299, a * 191 + 94);
        PlotIcon(&theRect, destIconHdl);
        MoveTo(235, a * 191 + 27);
        DrawString("\pDestination");

        SetRect(&theRect, 304, a * 191 + 30, 368, a * 191 + 94);
        PlotIcon(&theRect, sourceIconHdl);
        MoveTo(304, a * 191 + 27);
        DrawString("\pSource");
    }

    RGBForeColor(&gBlackColor);
    RGBBackColor(&gWhiteColor);
}
```

```

for(a=0;a<2;a++)
{
    if(a == 1)
    {
        RGBForeColor(&gYellowColor);
        RGBBackColor(&gRedColor);
    }

    for(b=0;b<8;b++)
    {
        SetRect(&theRect,b * 69 + 28,a * 191 + 121,b * 69 + 92,a * 191 + 185);
        PlotIcon(&theRect,destIconHdl);
    }
}

QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);

RGBForeColor(&gBlackColor);
RGBBackColor(&gWhiteColor);

HLock(sourceIconHdl);
sourceIconMap.baseAddr = *sourceIconHdl;
sourceIconMap.rowBytes = 4;
SetRect(&sourceIconMap.bounds,0,0,32,32);

destinationPixMapHdl = GetPortPixMap(GetQDGlobalsThePort());

for(a=0;a<2;a++)
{
    if(a == 1)
    {
        RGBForeColor(&gYellowColor);
        RGBBackColor(&gRedColor);
    }

    for(b=0;b<8;b++)
    {
        Delay(30,&finalTicks);
        SetRect(&theRect,b * 69 + 28,a * 191 + 121,b * 69 + 92,a * 191 + 185);
        CopyBits(&sourceIconMap,
            (BitMap *) *destinationPixMapHdl,
            &sourceIconMap.bounds,
            &theRect,
            b,NULL);
        GetIndString(sourceString,rBooleanStringList,b + 1);
        MoveTo(b * 69 + 28,a * 191 + 118);
        DrawString(sourceString);

        QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
    }
}

HUnlock(sourceIconHdl);

```

```

if(!gRunningOnX)
    SetThemeCursor(kThemeArrowCursor);
}

// ***** doArithmeticSourceModes

void doArithmeticSourceModes(void)
{
    Rect        portRect, sourceRect, destRect;
    Pattern      whitePattern;
    PicHandle     sourceHdl, destinationHdl;
    SInt16        a, b, arithmeticMode = 32;
    PixMapHandle  currentPixMapHdl;
    Str255        modeString;
    UInt32        finalTicks;

    SetWTitle(gWindowRef, "\pCopyBits with arithmetic source modes");

    RGBForeColor(&gBlackColor);
    RGBBackColor(&gWhiteColor);
    GetWindowPortBounds(gWindowRef, &portRect);
    FillRect(&portRect, GetQDGlobalsWhite(&whitePattern));

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    if(!(sourceHdl = GetPicture(rPicture)))
        ExitToShell();
    SetRect(&sourceRect, 44, 21, 201, 133);
    HNoPurge((Handle) sourceHdl);
    DrawPicture(sourceHdl, &sourceRect);
    HPurge((Handle) sourceHdl);
    MoveTo(44, 19);
    DrawString("\pSOURCE IMAGE");

    if(!(destinationHdl = GetPicture(rPicture + 1)))
        ExitToShell();
    HNoPurge((Handle) destinationHdl);
    for(a=44; a<403; a+=179)
    {
        for(b=21; b<274; b+=126)
        {
            if(a == 44 && b == 21)
                continue;
            SetRect(&destRect, a, b, a+157, b+112);
            DrawPicture(destinationHdl, &destRect);
        }
    }
    HPurge((Handle) destinationHdl);

    QDFlushPortBuffer(GetWindowPort(FrontWindow()), NULL);

    currentPixMapHdl = GetPortPixMap(GetWindowPort(gWindowRef));

```

```

for(a=44;a<403;a+=179)
{
    for(b=21;b<274;b+=126)
    {
        if(a == 44 && b == 21)
            continue;

        Delay(60,&finalTicks);

        GetIndString(modeString,rArithmeticStringList,arithmeticMode - 31);
        MoveTo(a,b - 2);
        DrawString(modeString);

        SetRect(&destRect,a,b,a+157,b+112);

        CopyBits((BitMap *) *currentPixMapHdl,
            (BitMap *) *currentPixMapHdl,
            &sourceRect,&destRect,
            arithmeticMode + ditherCopy,NULL);

        arithmeticMode ++;

        QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
    }
}

ReleaseResource((Handle) sourceHdl);
ReleaseResource((Handle) destinationHdl);

if(!gRunningOnX)
    SetThemeCursor(kThemeArrowCursor);
}

// ***** doHighlighting

void doHighlighting(void)
{
    Rect    portRect, theRect;
    Pattern whitePattern;
    RGBColor oldHighlightColor;
    SInt16   a;
    UInt8    hiliteVal;
    UInt32    finalTicks;

    SetWTitle(gWindowRef,"pHighlighting");

    RGBForeColor(&gBlackColor);
    RGBBackColor(&gWhiteColor);
    GetWindowPortBounds(gWindowRef,&portRect);
    FillRect(&portRect,GetQDGlobalsWhite(&whitePattern));

    LMGetHiliteRGB(&oldHighlightColor);

```

```

for(a=0;a<3;a++)
{
    MoveTo(50,a * 100 + 60);
    DrawString("\pClearing the highlight bit and calling InvertRect.");
    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
    Delay(60,&finalTicks);
    SetRect(&theRect,44,a * 100 + 44,557,a * 100 + 104);

    hiliteVal = LMGetHiliteMode();
    BitClr(&hiliteVal,pHiliteBit);
    LMSetHiliteMode(hiliteVal);

    if(a == 1)
        HiliteColor(&gYellowColor);
    else if(a == 2)
        HiliteColor(&gGreenColor);

    InvertRect(&theRect);
    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);

    MoveTo(50,a * 100 + 75);
    Delay(60,&finalTicks);
    DrawString("\pClick mouse to unhighlight. ");
    DrawString("\p(Note: The call to InvertRect reset the highlight bit ...");
    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);

    while(!Button()) ;

    MoveTo(45,a * 100 + 90);
    DrawString("\p... so we clear the highlight bit again before calling InvertRect.");
    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
    Delay(60,&finalTicks);

    LMSetHiliteMode(hiliteVal);

    InvertRect(&theRect);
    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
}

HiliteColor(&oldHighlightColor);

Delay(60,&finalTicks);
MoveTo(50,350);
DrawString("\pOriginal highlight color has been reset.");

QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
}

// ***** doDrawWithMouse

void doDrawWithMouse(void)
{
    Rect        portRect, drawRect;
    Pattern     whitePattern, blackPattern;

```

```

PixPatHandle pixpatHdl;
Point         initialMouse, previousMouse, currentMouse;
UInt16        randomNumber;
RGBColor      theColor;

RGBBackColor(&gWhiteColor);
GetWindowPortBounds(gWindowRef,&portRect);
FillRect(&portRect,GetQDGlobalsWhite(&whitePattern));

if(!(pixpatHdl = GetPixPat(rPixelFormat3)))
    ExitToShell();
PenPixPat(pixpatHdl);
PenSize(1,1);
PenMode(patXor);

GetMouse(&initialMouse);
drawRect.left = drawRect.right = initialMouse.h;
drawRect.top = drawRect.bottom = initialMouse.v;

GetMouse(&previousMouse);

while(StillDown())
{
    GetMouse(&currentMouse);

    if(currentMouse.v != previousMouse.v || currentMouse.h != previousMouse.h)
    {
        FrameRect(&drawRect);

        if(currentMouse.h >= initialMouse.h)
            drawRect.right = currentMouse.h;
        if(currentMouse.v >= initialMouse.v)
            drawRect.bottom = currentMouse.v;
        if(currentMouse.h <= initialMouse.h)
            drawRect.left = currentMouse.h;
        if(currentMouse.v <= initialMouse.v)
            drawRect.top = currentMouse.v;

        FrameRect(&drawRect);
    }

    previousMouse.v = currentMouse.v;
    previousMouse.h = currentMouse.h;
}

FrameRect(&drawRect);

theColor.red = doRandomNumber(0,65535);
theColor.green = doRandomNumber(0,65535);
theColor.blue = doRandomNumber(0,65535);
RGBForeColor(&theColor);

PenMode(patCopy);
PenPat(GetQDGlobalsBlack(&blackPattern));
BackPixPat(pixpatHdl);

```

```

randomNumber = doRandomNumber(0,3);

if(randomNumber == 0)
    PaintRect(&drawRect);
else if(randomNumber == 1)
    EraseRoundRect(&drawRect,50,50);
else if(randomNumber == 2)
    PaintOval(&drawRect);
else if(randomNumber == 3)
    PaintArc(&drawRect,0,doRandomNumber(0,360));

BackPat(&whitePattern);
}

// ***** doDrawingState

void doDrawingState(void)
{
    Rect            portRect, theRect;
    Pattern          whitePattern;
    ThemeDrawingState themeDrawingState;
    SInt16           a;
    UInt32           finalTicks;

    RGBBackColor(&gBlueColor);
    GetWindowPortBounds(gWindowRef,&portRect);
    FillRect(&portRect,GetQDGlobalsWhite(&whitePattern));
    SetWTitle(gWindowRef,"\pSaving and restoring the graphics port drawing state");

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    NormalizeThemeDrawingState();

    doDrawingStateProof(0);
    Delay(120,&finalTicks);

    GetThemeDrawingState(&themeDrawingState);

    theRect = portRect;
    theRect.right -= 300;

    SetThemeBackground(kThemeBrushListViewBackground,gPixelDepth,gIsColorDevice);
    EraseRect(&theRect);

    theRect.left += 150;

    SetThemeBackground(kThemeBrushListViewSortColumnBackground,gPixelDepth,gIsColorDevice);
    EraseRect(&theRect);

    SetThemePen(kThemeBrushListViewSeparator,gPixelDepth,gIsColorDevice);

    theRect.left -= 150;
    for(a=theRect.top;a<=theRect.bottom;a+=18)

```



```

    {
        MoveTo(theRect.left,a);
        LineTo(theRect.right - 1,a);
    }

    Delay(120,&finalTicks);
    doDrawingStateProof(1);
    Delay(120,&finalTicks);

    SetThemeDrawingState(themeDrawingState,true);

    doDrawingStateProof(2);

    if(!gRunningOnX)
        SetThemeCursor(kThemeArrowCursor);
}

// ***** doDrawingStateProof

void doDrawingStateProof(SInt16 phase)
{
    Rect theRect;

    MoveTo(324,phase * 117 + 41);
    if(phase == 0)
        DrawString("\pBefore calls to SetThemePen and SetThemeBackground");
    else if(phase == 1)
        DrawString("\pAfter calls to SetThemePen and SetThemeBackground");
    else if(phase == 2)
        DrawString("\pAfter restoration of graphics port drawing state");

    MoveTo(324,phase * 117 + 54);
    DrawString("\pPen pattern/color");
    MoveTo(462,phase * 117 + 54);
    DrawString("\pBackgrd pattern/color");

    SetRect(&theRect,324,phase * 117 + 58,438,phase * 117 + 132);
    PaintRect(&theRect);
    SetRect(&theRect,462,phase * 117 + 58,576,phase * 117 + 132);
    EraseRect(&theRect);

    QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
}

// ***** doGetDepthAndDevice

void doGetDepthAndDevice(void)
{
    GDHandle deviceHdl;

    deviceHdl = GetMainDevice();
    gPixelDepth = ((*deviceHdl)->gdPMap)->pixelSize;
    if(((1 <= gdDevType) & (*deviceHdl)->gdFlags) != 0)
        gIsColorDevice = true;
}

```

```
// ***** doRandomNumber

UInt16 doRandomNumber(UInt16 minimum, UInt16 maximum)
{
    UInt16 randomNumber;
    SInt32 range, t;

    randomNumber = Random();
    range = maximum - minimum + 1;
    t = (randomNumber * range) / 65536;
    return (t + minimum);
}

// *****
```

## Demonstration Program QuickDraw Comments

When this program is run, the user should choose items from the Demonstration menu and click the mouse button when instructed to do so by the advisory text in the window's title bar.

### defines

In addition to the usual constants relating to menus and the window, constants are established for pixel pattern, icon, string list, and picture resource IDs.

### Global Variables

The fields of the RGBColor global variables are assigned values representing the colors described by the variable names.

### main

Random numbers are used by various functions in the demonstration. The call to `SetQDGlobalsRandomSeed` seeds the random number generator. `randSeed` is a QuickDraw global variable which holds the seed value for the random number generator. Unless `randSeed` is modified, the same sequence of numbers will be generated each time the program is run. The parameter to the `GetDateTime` call receives the number of seconds since midnight, January 1, 1904, a value that is bound to be different each time the program is run.

Note that error handling in `main()`, as in other areas of the program, is somewhat rudimentary in that the program simply terminates.

### doEvents

Within the `mouseDown` case, at the `inContent` case, if the `mouseDown` is within the content region of the window when it is the front window and `gDrawWithMouseActivated` is true, the function `doDrawWithMouse` is called.

### **doDemonstrationMenu**

doDemonstrationMenu switches according to the user's choices in the Demonstration menu. In all but the iDrawWithMouse case, the only action taken is to call the relevant function.

Note that the global variable gDrawWithMouseActivated is set to false at function entry, and is set to true within the iDrawWithMouse case (which executes if the user chooses the Draw with Mouse item). Also note that the window's background is filled with the white color, using the white pattern, within this case.

### **doLines**

doLines demonstrates line drawing using colors, bit patterns, pixel patterns, and with the Boolean pattern mode patXor. doLines also demonstrates modifying the graphics port's clipping region so as to clip drawing to that modified region.

The first line sets the graphics pen's size, pattern, and pattern mode to the defaults. The next three lines fill the window's content area with blue.

The next block sets the window's clipping region to a rectangle 10 pixels inside the port rectangle. The first two lines define such a rectangle. The next two lines save the current clipping region for later restoration. The call to ClipRect establishes the new clipping region by setting it in the graphics port object.

### ***Lines Drawn with Foreground Color and Black Pen Pattern***

After the window title is set, FillRect is called with the white pattern with the background color is set to white. This fill is clipped to the current clipping region, which is a rectangle 10 pixels inside the port rectangle.

Within the for loop, random numbers between 0 and the width of the port rectangle are assigned to two variables which will be used to specify the starting and finishing horizontal coordinates for each of 60 drawn lines. The fields of an RGBColor variable are also assigned random values, this time between 0 and 65534 (one less than the maximum possible value for a UInt16). The call to RGBColor assigns this random color as the requested foreground color. The pen width is increased by two pixels. Finally, the call to MoveTo moves the pen to the random horizontal location at the top of the port rectangle, and the call to LineTo draws a line to the random horizontal location at the bottom of the port rectangle. The line drawing is clipped to the current clipping region.

### ***Lines Drawn with System-Supplied Bit Patterns***

This line drawing operation is similar to the previous one except that a system-supplied bit pattern is assigned to the graphics pen and the lines are drawn from left to right rather than top to bottom. The bit patterns are loaded by the call to GetIndPattern and are drawn from the 38

patterns in the 'PAT#' resource in the System file with resource ID `sysPatListID (0)`. The call to `PenPat` assigns the specified bit pattern to the graphics pen. In this operation, the height of the pen, rather than the width, is increased by two each time around the for loop.

### ***Lines Drawn with a Pixel Pattern***

In this line drawing operation, before the for loop is entered, `GetPixPat` is called to allocate a `PixPat` structure and initialize it with information from the specified 'ppat' resource. The call to `PenPixPat` then assigns this pixel pattern to the graphics pen.

After the last line is drawn, `DisposePixPat` is called to free the memory allocated by the `GetPixPat` call.

At this point, the clipping region saved at the start of the function is restored, and all of the memory allocated by the `NewRgn` call is freed.

### ***Lines Drawn with Pattern Mode `patXor`***

This block demonstrates a well-known but nonetheless exotic capability of the humble line when it operates in the pattern mode `patXor`.

The content area is filled with red, following which the pen size and pen pattern are set to the defaults. The call to `PenMode` sets the pen mode to `patXor`. The next four lines assign values to four variables that will be used to ensure that the starting and ending locations of each drawn line will be ten pixels inside the port rectangle. The for loops, proceeding clockwise, draw lines from points 10 pixels inside the periphery of the port rectangle through the center of the rectangle to points on the opposite side of the rectangle. The effect of `patXor` on any destination pixel is to invert it. For example, assuming a white background and black pen color, any white pixel in the path of the drawn lines will be turned black and any black pixel will be turned white. This produces a pattern known as a moire (watered silk) pattern.

### ***doFrameAndPaint***

`doFrameAndPaint` demonstrates the use of QuickDraw's framing and painting functions with the exception of those relating to polygons and regions.

At the first two lines, the pen pattern and mode are set to the defaults and the pen size is set to 30 pixels wide and 20 pixels high.

The for loop is traversed three times, once for framing and painting with a color, once for framing and painting with a bit pattern, and once for framing and painting with a pixel pattern. The first action is to fill the port rectangle with the color white using the white pattern.

### ***Preparation***

The first time around the loop, `RGBForeColor` is called to set the requested foreground color to red.

The second time around the loop, `RGBForeColor` and `RGBBackColor` are called to set the requested foreground and background colors to, respectively, blue and yellow, `GetIndPattern` loads one of the system-supplied bit patterns, and `PenPat` makes that pattern the pen's current bit pattern.

The third time around the loop, a call to `GetPixPat` loads a 'ppat' resource, creating a new `PixPat` structure, and a call to `PenPixPat` assigns that pixel pattern to the pen.

### ***Framing and Painting***

In this section, `SetRect` is used to assign the coordinates of a rectangle to the fields of a `Rect` structure, and `OffsetRect` is used to move the rectangle horizontally and vertically between the calls to the various framing and painting functions.

Before `doFrameAndPaint` exits, `DisposePixPat` is called to free the memory allocated by the `GetPixPat` call.

### ***doFillEraseInvert***

`doFillEraseInvert` demonstrates the use of `QuickDraw`'s filling, erasing, and inverting functions with the exception of those relating to polygons and regions.

At the first two lines, the pen pattern and mode are set to the defaults and the pen size is set to 30 pixels wide and 20 pixels high.

The for loop is traversed four times, once for filling and erasing with colors, once for filling and erasing with bit patterns, once for filling and erasing with a pixel patterns, and once for inverting. The first action, on the first three passes only, is to fill the port rectangle with the color white using the white pattern.

### ***Preparation***

The first time around the loop, `RGBForeColor` and `RGBBackColor` are called to set the requested foreground and background colors to, respectively, blue and red. In addition, the calls to `GetIndPattern` and `BackPat` set the background pattern to black.

The second time around the loop, `RGBForeColor` and `RGBBackColor` are called to set the requested foreground and background colors to, respectively, blue and yellow. In addition, `GetIndPattern` is called twice, once to assign a bit pattern to a `Pattern` variable which will be passed as the second parameter in calls to `FillRect`, `FillOval`, and so on, and once, in conjunction with `BackPat`, to assign a bit pattern to the graphics port's `bkPixPat` field.

The third time around the loop, `GetPixPat` is called twice, once to assign a pixel pattern to a the variable which will be passed as the second parameter in calls to `FillRect`, `FillOval`, and so on, and once, in conjunction with `BackPixPat`, to assign a pixel pattern to the graphics port's `bkPixPat` field.

The fourth time around the loop, and preparatory to calls to the erasing functions, the call to `BackPat` sets the background pattern to white. (The calls to `SetRect` and `EraseRect` simply erase the existing text in the window.)

### ***Filling, Erasing, and Inverting***

In this section, `SetRect` is used to assign the coordinates of a rectangle to the fields of a `Rect` structure, and `OffsetRect` is used to move the rectangle horizontally and vertically between the calls to the various filling, erasing, and inverting functions.

Before `doFillEraseInvert` exits, `DisposePixPat` is called twice to free the memory allocated by the two `GetPixPat` calls.

### ***doPolygonAndRegion***

`doPolygonAndRegion` demonstrates defining a polygon and a region and the use of some of QuickDraw's polygon and region framing, painting, filling, and erasing functions.

#### ***Preparation***

The calls to `GetIndPattern` and `BackPat` set the background pattern to one on the system-supplied bit patterns. The call to `GetPixPat` gets the pixel pattern to be used by the filling functions. The calls to `RGBForeColor` and `RGBBackColor` set the requested foreground and background colors. `PenNormal` sets the pen's size, pattern mode, and pattern to the defaults.

The `OpenPoly` call initiates the recording of the polygon definition, the `MoveTo` and `LineTo` calls define the polygon, and `ClosePoly` stops the recording. Note that, in this demonstration, the last vertex is not joined to the first vertex.

The `NewRgn` call allocates memory for a new region and a region pointer, initializes the contents of the region and make it an empty rectangle. `OpenRgn` initiates the recording of a region shape. The next seven lines create a region definition comprising two rectangles and an overlapping oval. `CloseRgn` terminates the recording.

#### ***Framing, Painting, Filling, and Erasing***

In this section, `OffsetPoly` and `OffsetRgn` are used to move the polygon and region horizontally between the calls to the framing, filling, and erasing functions. `OffsetPoly` modifies the polygon's definition. `OffsetRgn` adjusts the coordinates of the region.

Before `doPolygonAndRegion` exits, `KillPoly` is called to free all the memory allocated by `OpenPoly`, `DisposeRgn` is called to free all the memory allocated by `NewRgn`, `DisposePixPat` is called to free all the memory allocated by `GetPixPat`, and the background pattern is set to white.



### doText

doText draws text in various fonts, sizes and styles. In addition, the last block demonstrates drawing justified text within a specified rectangle using the TextEdit function TETextBox.

Prior to the for loop, the variable windowCenter is assigned a value which represents a location midway across the port rectangle, and the right half of the content area is filled with blue.

Within the first section of the for loop, the text font is changed using GetFNum and TextFont, the text style is changed using TextFace, and the foreground color is changed. At the last two sections within the loop, the text size is changed using TextSize, a string is retrieved from a 'STR#' resource, the width of the string in pixels is determined, and the string is drawn centered laterally in the window.

After the loop exits, the text font, size and style are returned to Geneva 10pt plain.

At the final block, a small rectangle is defined at the bottom left of the content area. Because the current background color is blue, the call to EraseRect erases the rectangle in that color. The rectangle is then inset by five pixels all round. A string is then loaded from a 'STR#' resource and the foreground color is set to white. Finally, TETextBox is called to draw the text within the specified rectangle with left justification. (Other available justification constants are teFlushRight and teCenter.)

### doScrolling

doScrolling demonstrates scrolling pixels within a specified rectangle, with the operation clipped to a region comprising two unconnected rectangular areas.

The first call to GetPixPat loads a 'ppat' resource. The call to PenPixPat assigns that pixel pattern to the pen, which is then made 50 pixels wide and zero pixels high. A framed rectangle is then drawn in the left half of the window. (Note that, because the pen height is set to zero, the two sides of the rectangle will be drawn but not the top and bottom.) A filled rectangle is then drawn in the right side of the window using the same pixel pattern.

In the next block, another 'ppat' resource is retrieved. The call to BackPixPat makes this pixel pattern the background pixel pattern.

The next block creates a region comprising two separate rectangles, the first one coincident with the “inside” of the framed rectangle and the second one coincident with the whole of the filled rectangle). The current clipping region is then saved and the newly created region is established as the current clipping region.

The following call to SetRect defines a rectangle for the first parameter of the ScrollRect function. Laterally, this extends from the left inside of the framed rectangle to the right hand side of the filled rectangle. The call to NewRgn then creates the empty region required by the



`ScrollRect` calls.

In the first for loop, the pixels within the clipping region within the specified rectangle are scrolled down, the top of the rectangle being incremented down between calls to `ScrollRect`. `ScrollRect` fills the “vacated” areas with the background pattern.

Between the for loops, the rectangle used by `ScrollRect` is redefined and the background pixel pattern is changed to the pixel pattern used to draw the original rectangles. The scrolling operation is then repeated, this time in an upward direction.

Before `doScrolling` exits, the saved clipping region is restored and all the memory allocated by the `GetPixPat` and `NewRgn` calls is freed.

### **doBooleanSourceModes**

`doBooleanSourceModes` demonstrates the effects of the Boolean source modes in both black-and-white and color.

The first block fills the content area with green and then fills the top half of the content area with white. This block leaves the foreground color black and the background color white.

The next block loads two 32-bit by 32-bit 'ICON' resources. One icon contains the image of a cross and the other contains the image of a square.

The first for loop calls `PlotIcon` four times, twice to draw the icons in the white area at the top of the window, and twice to draw them in the green area at the bottom of the window. The rectangle passed in the first parameter of the `PlotIcon` calls expands the icon to 64 pixels by 64 pixels. The calls to `RGBForeColor` and `RGBBackColor` cause the icons in the green area to be drawn using a foreground color of yellow and a background color of red.

The foreground and background colors are reset to black and white before the second for loop is entered.

The second for loop draws the cross icon eight times across the bottom of the white half of the window. The foreground and background colors are then changed to yellow and red before this process is repeated across the bottom of the green area of the window.

The foreground and background colors are again reset to black and white.

As a preamble to what is to come, note that there is no special data type for an icon. It is simply 128 bytes of bit data arranged as 32 rows of 4 bytes per row. All that is available is a handle to that 128 bytes of data. The intention is to cause the 128 bytes of data which constitutes the square icon to be regarded as bitmap data pointed to by the `baseAddr` field of a `BitMap` structure. That way, the `CopyBits` routine can be used to copy the bitmap into the graphics port.

Because `CopyBits` is one of those functions which can move memory around, the first action is to lock the icon data in the heap. The address of the square icon image data is then assigned to the `baseAddr` field of a `BitMap` structure, the `rowBytes` field is assigned the value 4, and the `bounds` field is assigned a rectangle defining the normal icon size.

The final for loop calls `CopyBits` to copy the bit image into the graphics port sixteen times, overdrawing the previously drawn cross icons. The call to `SetRect` within the inner for loop defines the expanded destination rectangle that governs the size at which the image will be drawn. This rectangle is passed in the `destRect` parameter of the `CopyBits` call. Note that, in the `CopyBits` call, the value passed in the `tMode` (transfer mode) parameter is incremented each time through the loop so that the square image overdraws the cross image once in each of the eight available Boolean source modes. The three lines following the `CopyBits` call retrieve the appropriate string containing the relevant source mode from the specified 'STR#' resource and draw this string above each copied image.

The last line unlocks the icon image data.

### **doArithmeticSourceModes**

`doArithmeticSourceModes` demonstrates the effects of the arithmetic source modes.

Since `CopyBits` will be called, the foreground and background colors are set to black and white respectively. The call to `FillRect` clears the window to white.

The first call to `GetPicture` loads a 'PICT' resource into a `Picture` structure. (Because the 'PICT' resource is purgeable, it is made non-purgeable as soon as it is retrieved, used immediately, and immediately made purgeable again.) The call to `DrawPicture` draws the picture in the top left of the window, where it is labeled as the source image.

The second call to `GetPicture` loads another 'PICT' resource that will be used as the destination image. The first for loop draws this picture in the window at eight separate locations, these locations being determined by the rectangle passed in the first parameter of the `DrawPicture` calls.

The last for loop is traversed once for each of the eight arithmetic source modes. `CopyBits` is called eight times to overdraw the destination images with the source image. Note that the value in the `tMode` (transfer mode) parameter of the `CopyBits` call is incremented each time around the loop. Note also that each time around the loop a new string is retrieved from a 'STR#' resource and drawn above the destination image.

Before `doArithmeticSourceModes` exits, `ReleaseResource` is called twice to free the memory allocated by the `GetPicture` calls.

## doHighlighting

doHighlighting demonstrates highlighting, first with the color set by the user in the Appearance pane of the Appearance control panel (Mac OS 8/9) or in System Preferences (Mac OS X), and then with two colors set by the program.

The highlight color set by the user is saved via a call to `LMGetHiliteRGB`.

The for loop is traversed three times. On the second and third traverses, the highlight color is changed.

Within the for loop, a copy of the value at the low memory global `HiliteMode` is retrieved using `LMGetHiliteMode`, `BitClr` is called to clear the highlight bit, and `LMSetHiliteMode` is called to set to low memory global to this new value. At the if/else block, the highlight color is changed if this is the second or third time around the loop. With the highlight bit cleared, `InvertRect` is called to invert a specified rectangle.

Note that the call to `InvertRect` resets the highlight bit. Accordingly, when the user clicks the mouse button, the highlight bit is cleared once again before `InvertRect` is called once again. This second call restores the color in the specified rectangle to the background color.

Before the `doHighLighting` function returns, it sets the highlight color to the saved highlight color.

## doDrawWithMouse

`doDrawWithMouse` demonstrates the use of the mouse to define bounding rectangles for QuickDraw shape drawing functions. It also demonstrates the implementation of the “rubber band” rectangle commonly used to provide visual feedback to the user as he drags the mouse during such operations. (While the mouse button remains down, the “rubber-band” rectangle is continually erased and redrawn as the mouse is moved. It is erased when the mouse button is released.)

`doDrawWithMouse` is called when a mouse-down occurs in the window while it is the front window, provided that the global variable `gDrawWithMouseActivated` is set to true.

The call to `GetPixPat` loads a 'ppat' resource containing a small 8-pixel by 8-pixel pattern. This pixel pattern is assigned to the pen by the call to `PenPixPat`. The call to `PenSize` makes the pen size one pixel high by one pixel wide. The pen pattern mode is then set to `patXOr`. (Note: For a black-and-white “rubber band,” replace the `PenPixPat` call with

```
PenPat(GetQDGlobalsGray(&grayPattern));
```

The call to `GetMouse` saves the initial mouse location to a `Point` variable. The contents of the fields of this variable will remain unchanged. Those coordinates are also used to initialize the left and top fields of the `Rect` variable `drawRect`.

The next call to `GetMouse` assigns the initial location of the mouse to another `Point` variable. The contents of the fields of this variable will continually change as the mouse is dragged.

The while loop continues to execute while the mouse button remains down. Within the loop, the current mouse location is retrieved and compared with the previous mouse location (the first if statement). If the mouse has moved

- `FrameRect` is called to draw the framed rectangle.
- If the current mouse horizontal coordinate is greater than or equal to the initial horizontal mouse coordinate, the current mouse horizontal coordinate is assigned to the right field of the rectangle.
- If the current mouse vertical coordinate is greater than or equal to the initial vertical mouse coordinate, the current mouse vertical coordinate is assigned to the bottom field of the rectangle.
- If the current mouse horizontal coordinate is less than or equal to the initial horizontal mouse coordinate, the current mouse horizontal coordinate is assigned to the left field of the rectangle.
- If the current mouse vertical coordinate is less than or equal to the initial vertical mouse coordinate, the current mouse vertical coordinate is assigned to the top field of the rectangle.
- `FrameRect` is called again with the newly defined rectangle passed in.

Because the drawing mode is `patXor`, the first call to `FrameRect` erases the old rectangle. Because `FrameRect` is only called if the mouse has moved, the flicker which would otherwise occur when the mouse is stationary is avoided.

Below the if block, and preparatory to the next comparison of current and previous mouse location, the current mouse location becomes the previous mouse location.

When the mouse button is released

- The final call to `FrameRect` erases the final “rubber-band” rectangle.
- The foreground color is set to a random color, the pen pattern mode is set to `patCopy`, the pen pattern is set to black, and the background pixel pattern is set to that previously used to draw the “rubber band.”
- The rectangle as at mouse button release is used in calls to `QuickDraw` painting and erasing functions to draw rectangles, round rectangles, ovals, and arcs. Just which function is called depends on the value returned by the call to `doRandomNumber`.
- The background pattern is set to white.

### **doDrawingState**

`doDrawingState` is similar to the function `doDrawListView` in the demonstration program *Appearance*, the difference being that, in `doDrawingState`, the drawing state is saved at entry and restored at exit.

Note that the call to `NormalizeThemeDrawingState` is included in this function for demonstration purposes only. Ordinarily, this function would be called (if required) at other points in an application.

The call to `GetThemeDrawingState` saves the drawing state prior to the calls to the Appearance Manager functions `SetThemeBackground` and `SetThemePen`, which will change either the color or the pattern settings in the graphics port.

The call to `SetThemeDrawingState` restores the saved drawing state.

The intervening code simply draws a Mac OS 8/9-type list view in the left half of the window.

The calls to `doDrawingStateProof` are also for demonstration purposes only. As will be seen, this function simply draws rectangles in the right half of the window in the pen and background colors and patterns as they were after the call to `NormalizeThemeDrawingState`, after the calls to the Appearance Manager functions, and after the call to `SetThemeDrawingState`.

### **doDrawingStateProof**

`doDrawingStateProof` is called by `doDrawingState` to draw rectangles in the right half of the window in the pen and background colors and patterns as they were after the call to `NormalizeThemeDrawingState`, after the calls to the Appearance Manager functions, and after the call to `SetThemeDrawingState`.

### **doRandomNumber**

`doRandomNumber` is incidental to the demonstration.

The use of the QuickDraw random number generator is quite adequate for the purposes of this demonstration. However, a professional programmer would not regard it as measuring up to the minimal standards of a “serious” random number generator. (See the article on random number generators at

<http://www.mactech.com/articles/mactech/Vol.08/08.03/RandomNumbers/index.html>.)





# Offscreen Graphics Worlds, Pictures, Cursors, and Icons

## CHAPTER

# 13

## IN THIS CHAPTER

- Offscreen Graphics Worlds 602
- Pictures 605
- Cursors 608
- Icons 614
- Main Constants, Data Types and Functions—  
Offscreen Graphics Worlds 619
- Main Constants, Data Types and Functions—  
Pictures 620
- Main Constants, Data Types and Functions—  
Cursors 622
- Appearance Manager Constants, Data Types and  
Functions—Cursors 624
- Main Constants, Data Types and Functions—  
Icons 624
- Demonstration Program GworldPicCursIcn  
Listing 627
- Demonstration Program GWorldPicCursIcn  
Comments 650



## Offscreen Graphics Worlds

### Introduction

An **offscreen graphics world** may be regarded as a virtual screen on which your application can draw a complex image without the user seeing the various steps involved. When your application draws into an offscreen graphics world, it draws into a part of memory not used by the video device. Thus the drawing process remains hidden from the user. When the drawing is completed, your application can copy the image from the offscreen graphics world to the active window using the `CopyBits`, `CopyMask`, or `CopyDeepMask` functions.

One of the key advantages of using an offscreen graphics world is speed. Copying a complex image from an offscreen graphics world to the active window is much faster than performing all the steps necessary to draw the image on-screen.

### Creating an Offscreen Graphics World

The `NewGWorld` function is used to create an offscreen graphics world:

```
QDErr NewGWorld(GWorldPtr *offscreenGWorld, short PixelDepth, const Rect *boundsRect,
                CTabHandle cTable, GDHandle aGDevice, GWorldFlags flags)
```

**Returns:** A result code: `noErr` (no error); `paramErr` (illegal parameter); `cDepthErr` (invalid pixel depth).

**offscreenGWorld** Pointer to the created offscreen graphics world.

**PixelDepth** Pixel depth of the offscreen graphics world. Possible depths are 0, 1, 2, 4, 8, 16, and 32 bits per pixel. Specifying 0 sets the pixel depth to equal the greatest depth of those screens whose boundary rectangles intersect the rectangle passed in the `boundsRect` parameter. 0 also causes `NewGWorld` to use the `GDevice` structure for this deepest device rather than create a new one.

**boundsRect** The offscreen pixel map's boundary and port rectangle. Applications typically pass in the port rectangle of the window to which the image in the offscreen graphics world will be copied.

**cTable** Handle to a `ColorTable` structure. May be `NULL`.

**aGDevice** Handle to a `GDevice` structure. This is used only when `noNewDevice` is passed in the `flags` parameter. `NewGWorld` will attach this `GDevice` structure to the offscreen graphics world. Should be `NULL` if 0 is passed in the `PixelDepth` parameter.

`flags` Any combination of `pixPurge` (make base address of pixel image purgeable), `noNewDevice` (do not create offscreen `GDevice` structure), `useTempMem` (create base address for offscreen pixel image in temporary memory), and `keepLocal` (keep offscreen pixel image in main memory) may be passed in this parameter.

Calling `NewGWorld` results in the creation of a new offscreen graphics port. The function returns, in the `offscreenGWorld` parameter, a pointer of type `GWorldPtr` which points to the graphics port:

```
typedef CGrafPtr GWorldPtr;
```

`NewGWorld` also establishes a link to an existing `GDevice` structure, or creates a new `GDevice` structure and establishes a link to that.

Passing `0` in the `PixelDepth` parameter, a window's port rectangle in the `boundsRect` parameter, `NULL` in both the `cTable` and `agDevice` parameters, and `0` in the `flags` parameter:

- Allows `QuickDraw` to optimize the `CopyBits`, `CopyMask`, and `CopyDeepMask` functions used to copy the image into the window's port rectangle.
- Results in the default behavior of `NewGWorld`, meaning that the base address of the offscreen pixel image is unpurgeable, memory in the application heap is used, and graphics accelerators can cache the offscreen pixel image.

## Setting the Graphics Port

Before drawing into the offscreen graphics port, you should save the current graphics port and the current device's `GDevice` structure by calling `GetGWorld`. The offscreen graphics port should then be made the current port by a call to `SetGWorld`. After drawing into the offscreen graphics world, you should call `SetGWorld` to restore the saved graphics port as the current graphics port.

`SetGWorld` takes two parameters (port and `gdh`). If the port parameter is of type `CGrafPtr`, the current port is set to the port specified in the port parameter and the current device is set to the device specified in the `gdh` parameter. If the port parameter is of type `GWorldPtr`, the current port is set to the port specified in the port parameter, the `gdh` parameter is ignored, and the current device is set to the device linked to the offscreen graphics world.

## Preparing to Draw into an Offscreen Graphics World

After setting the offscreen graphics world as the current port, you should use the `GetGWorldPixmap` function to get a handle to the offscreen pixel map. This is required as the parameter in a call to the `LockPixels` function, which you must call before drawing to, or copying from, an offscreen graphics world.

`LockPixels` prevents the base address of an offscreen pixel image from being moved while you draw into it or copy from it. It returns `true` if the base address is not purgeable, or if the base address has not been purged by the Memory Manager. If `LockPixels` returns `false`, (meaning that the base address of the offscreen pixel image has been purged) your application must call the `UpdateGWorld` function to reallocate the offscreen pixel image and then reconstruct it.

As a related matter, note that the `baseAddr` field of the `PixMap` structure for an offscreen graphics world contains a handle, whereas the `baseAddr` field for an onscreen pixel map contains a pointer. Accordingly, the `GetPixBaseAddr` function must be used to obtain a pointer to the `PixMap` structure for an offscreen graphics world.

## Copying an Offscreen Image into a Window

After drawing the image in the offscreen graphics world, your application should call `SetGWorld` to set the active window as the current graphics port preparatory to copying the image to that port.

Your application copies the image from the offscreen graphics world into the target window using `CopyBits` (or, if masking is required, `CopyMask` or `CopyDeepMask`). Note that `CopyBits`, `CopyMask` and `CopyDeepMask` expect their source and destination parameters to be pointers to bit maps, not pixel maps. (These functions date from the era of black-and-white Macintoshes, which is why they expect a pointer to a bitmap. By looking at certain information in the graphics ports, `CopyBits`, `CopyMask`, and `CopyDeepMask` can establish that you have passed the functions a handle to a pixel map rather than the base address of a bitmap.)

You must leave the pixel image locked while you are drawing into an offscreen graphics world or copying an image from it, and you should call `UnlockPixels` when you are finishing the copying or drawing operation. (Calling `UnlockPixels` will assist in preventing heap fragmentation.)

## Updating an Offscreen Graphics World

If, for example, you are using an offscreen graphics world to support the window updating process, you can use `UpdateGWorld` to carry certain changes affecting the window (resizing the window, changes to the pixel depth of the screen, and so on) through to the offscreen graphics world. Calling `UpdateGWorld` obviates the necessity to re-create the offscreen graphics world and redraw its contents.

## Disposing of an Offscreen Graphics World

You should call `DisposeGWorld` when your application no longer needs the offscreen graphics world.

# Pictures

## Introduction

QuickDraw provides a set of functions that allow your application to record a number of drawing commands and subsequently play the recording back. The collection of drawing commands is called a **picture**.

You begin defining a picture by calling the function `OpenCPicture`. Your subsequent drawing commands are collected in a data structure of type `Picture`. The picture defined within this data structure may be drawn by calling the function `DrawPicture`.

The `OpenCPicture` function creates pictures in the **extended version 2 format**, which allows your application to specify resolutions for pictures.

## The Picture Structure

The `Picture` structure is as follows:

```
struct Picture
{
    short picSize;
    Rect  picFrame;
};
typedef struct Picture Picture;
typedef Picture *PicPtr;
typedef PicPtr *PicHandle;
```

### Field Descriptions

`picSize` This field is irrelevant for version 2 format and extended version 2 format pictures.

#### NOTE

To determine the size of a picture in memory, use the Memory Manager function `GetHandleSize`. To determine the size of a picture in a file of type 'PICT', use the File Manager function `PBGetFInfo`. To determine the size of a picture in a resource of type 'PICT', use the Resource Manager function `MaxSizeResource`.

`picFrame` The picture's bounding rectangle. When you draw into a differently sized rectangle, `DrawPicture` uses this rectangle to scale the picture.

... Compact drawing commands and picture comments constitute the rest of the structure, which is of variable length.

## Opcodes: Drawing Commands and Picture Comments

The variable length field in a `Picture` structure contains data in the form of **opcodes**, which `DrawPicture` uses to determine what objects to draw or what mode to change for subsequent drawing. Opcodes can also specify **picture comments**, which are created using `PicComment`. A picture comment contains data or commands for special processing by output devices, such as PostScript printers.

You typically use `QuickDraw` commands when drawing to the screen and picture comments to include any special drawing commands for printers.

## 'PICT' Files, Resources, and Scrap Format

File Manager and Resource Manager functions are used to read pictures from, and write pictures to, a disk. Scrap Manager functions are used to read pictures from, and write pictures to, the scrap (see Chapter 20).

A picture can be stored as a 'PICT' resource in the resource fork of any file type. A picture can also be stored in the data fork of a file of type 'PICT'. The first 512 bytes of the data fork of a 'PICT' file are a header that your application can use for its own purposes.

The Scrap Manager maintains a storage area to hold the last data cut or copied by the user. This area is called the **scrap**. If your application supports cut, copy, and paste operations, it necessarily reads data from, and writes data to, the scrap. There are two standard scrap data formats, one of which is 'PICT'.

## Creating Pictures

As previously stated, you use the `OpenCPicture` function to begin defining a picture. You pass information to `OpenCPicture` in the form of an `OpenCPicParams` structure:

```
struct OpenCPicParams
{
    Rect  srcRect;    // Optimal bounding rectangle.
    Fixed hRes;       // Best horizontal resolution.
    Fixed vRes;       // Best vertical resolution.
    short version;    // Set to -2.
    short reserved1;  // (Reserved. Set to 0.)
    long  reserved2;  // (Reserved. Set to 0.)
};
typedef struct OpenCPicParams OpenCPicParams;
```

This structure provides a simple mechanism for specifying resolutions when creating images. For example, applications that create pictures from scanned images can specify resolutions higher than 72 dpi.

You call `ClosePicture` to complete the collection of drawing (and picture comment) commands that define your picture.

## Clipping Region

Before calling `OpenCPicture`, you should always use `ClipRect` to specify an appropriate clipping region. If you fail to do this, `OpenCPicture` will use the clipping region contained in the current graphics port object. By default, this region is very large (the size of the coordinate plane). In this circumstance, if you scale the picture when drawing it, the clipping region can become invalid and your picture will not be drawn. By the same token, if your application has previously set the clipping region for some other purpose, part of your drawing may be clipped.

Ordinarily, you should set the clipping region to equal the port rectangle of the current graphics port before recording a picture.

## Opening and Drawing Pictures

You can retrieve pictures saved in 'PICT' files using File Manager functions. You can retrieve pictures saved in the resource forks of other file types using the `GetPicture` function. You can retrieve pictures stored in the scrap using the Carbon Scrap Manager function `GetScrapFlavorData`.

### NOTE

The demonstration program in Chapter 18 shows how to read pictures from, and save pictures to, files of type 'PICT'.

When the picture is retrieved, you can call `DrawPicture` to draw the picture. The second parameter passed in the `DrawPicture` function is the destination rectangle, which should be specified in coordinates local to the current graphics port. `DrawPicture` shrinks or stretches the picture as necessary to make it fit into this rectangle.

When you are finished using a picture stored as a 'PICT' resource, you should use the resource Manager function `ReleaseResource` to release its memory.

## Saving Pictures

To save a picture in a 'PICT' file, you should use the appropriate File Manager functions. (Remember that the first 512 bytes of a 'PICT' file are reserved for your application's own purposes.) To save pictures in a 'PICT' resource, you should use the appropriate Resource

Manager functions. To place a picture in the scrap (for example, to respond to the user choosing the Copy command to copy a picture to the clipboard), you should use the Carbon Scrap Manager function `PutScrapFlavorData`.

## Gathering Picture Information

`GetPictInfo` may be used to gather information about a single picture, and `GetPixMapInfo` may be used to gather color information about a single pixel map or bit map. Each of these functions returns color and resolution information in a `PictInfo` structure. A `PictInfo` structure can also contain information about the drawing objects, fonts, and comments in a picture.

## Cursors

### Introduction

A **cursor** is a 16-by-16 pixel image defined in a black-and-white cursor ('CURS') or color cursor ('crsr') resource.

### Cursor Movement, Hot Spot, Visibility, and Shape

#### Cursor Movement

Cursor movement is not the responsibility of your application. When the mouse is moved by the user, low-level interrupt-driven mouse functions move the cursor on the screen.

#### Cursor Hot Spot

A cursor's **hot spot** is that part of the cursor that actually points to an object on the screen. Mouse clicks only have an effect on that object when the hot spot, not the cursor as a whole, is over the object. Fig 1 illustrates two cursors and their hot spot points. Note that the hot spot is a point, not a bit.

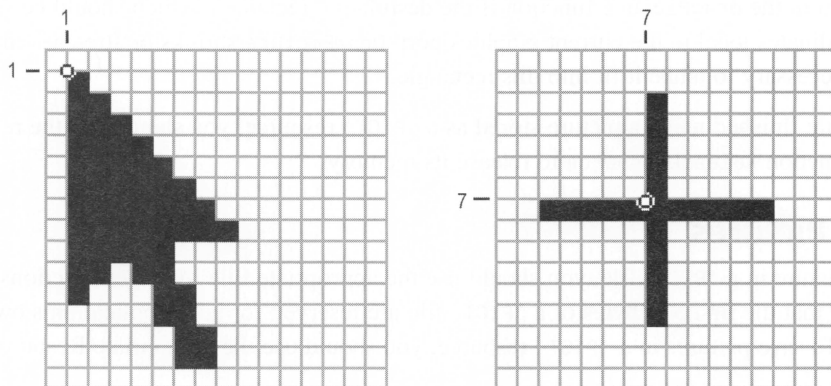


FIG 1 - CURSOR HOT SPOTS



## Cursor Visibility

Generally speaking, your application should always make the cursor visible. There are, however, exceptions to this rule. For example, in a text-editing application, the cursor should be made invisible, and the insertion point made to blink, when the user begins entering text. In such cases, the cursor should be made visible again only when the user moves the mouse.

## Cursor Shape

Your application should change the shape of the cursor in the following circumstances:

- To indicate that the user is over a certain area of the screen. When the cursor is in the menu bar, for example, it should usually have an arrow shape. When the user moves the cursor over a text document, the cursor shape should be changed to the I-beam shape.
- To provide feedback to the user indicating that a time-consuming operation is in progress. For example, if an operation will take a second or two, you should provide feedback to the user by changing the cursor to the wristwatch cursor (on Mac OS 8/9) or wait cursor (Mac OS X) (see Fig 2). If the operation will take several seconds and the only options available to the user are to stop the operation, wait until it is completed, or switch to another application, you should display an animated cursor (on Mac OS 8/9) or wait cursor (on Mac OS X).

### NOTE

If the operation takes longer than several seconds, you should display a dialog with a progress indicator (see Chapter 25).

## Non-Animated Cursors

### System 'CURS' and 'crsr' Resources

The system contains a number of 'CURS' and 'crsr' resources. The following constants represent the 'CURS' resource IDs for the basic cursors shown in Fig 2:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
iBeamCursor	1	Used in text editing
crossCursor	2	Often used for manipulating graphics
plusCursor	3	Often used for selecting fields in an array
watchCursor	4	Used when a short operation is in progress



**FIG 2 - THE I-BEAM, CROSSHAIRS, PLUS SIGN, AND WRISTWATCH CURSORS**

The following lists the 'CURS' and 'crsr' resource IDs for the additional cursors shown in Fig 3:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
-	-20488	Contextual menu arrow cursor
-	-20487	Alias arrow cursor
-	-20486	Copy arrow cursor
-	-20452	Resize left cursor. (Not available on Mac OS X.)
-	-20451	Resize right cursor. (Not available on Mac OS X.)
-	-20450	Resize left/right cursor. (Not available on Mac OS X.)
-	-20877	Pointing hand cursor. (Not available on Mac OS X.)
-	-20876	Open hand pointer. (Not available on Mac OS X.)
-	-20875	Close hand pointer. (Not available on Mac OS X.)



**FIG 3 - ADDITIONAL CURSOR AND COLOUR CURSOR RESOURCES**

### Custom 'CURS' and 'crsr' Resources

To create custom cursors, you need to define 'CURS' or 'crsr' resources in the resource file of your application.

### Changing Cursor Shape

Your application is responsible for setting the initial appearance of the cursor and for changing the appearance of the cursor as appropriate for your application.

#### Methodology 1

One method for changing cursor shape involves first getting a handle to the relevant cursor (either a custom cursor or one of the system cursors shown in Figs 2 and 3) by specifying its resource ID in a call to `GetCursor` or `GetCCursor`. `GetCursor` returns a handle to a `Cursor` structure. `GetCCursor` returns a handle to a `CCrsr` structure. The address of the `Cursor` or `CCrsr` structure is then used in a call to `SetCursor` or `SetCCursor` to change the cursor shape.

## Methodology 2

Mac OS 8.5 introduced a new method for setting the cursor. You must pass one of the following constants, which are of type `ThemeCursor`, in the `inCursor` parameter of the function

`SetThemeCursor`:

<i>Constant</i>	<i>Value</i>	<i>Comments</i>
<code>kThemeArrowCursor</code>	0	
<code>kThemeCopyArrowCursor</code>	1	
<code>kThemeAliasArrowCursor</code>	2	
<code>kThemeContextualMenuArrowCursor</code>	3	
<code>kThemeIBeamCursor</code>	4	
<code>kThemeCrossCursor</code>	5	
<code>kThemePlusCursor</code>	6	
<code>kThemeWatchCursor</code>	7	Can animate
<code>kThemeClosedHandCursor</code>	8	
<code>kThemeOpenHandCursor</code>	9	
<code>kThemePointingHandCursor</code>	10	
<code>kThemeCountingUpHandCursor</code>	11	Can animate
<code>kThemeCountingDownHandCursor</code>	12	Can animate
<code>kThemeCountingUpAndDownHandCursor</code>	13	Can animate
<code>kThemeSpinningCursor</code>	14	Can animate
<code>kThemeResizeLeftCursor</code>	15	
<code>kThemeResizeRightCursor</code>	16	
<code>kThemeResizeLeftRightCursor</code>	17	

## Changing Cursor Shape in Response to Mouse-Moved Events

Most applications set the cursor to the I-beam shape when the cursor is inside a text-editing area of a document, and they change the cursor to an arrow when the cursor is inside the scroll bars. Your application can achieve this effect by requesting that the Event Manager report mouse-moved events if the user moves the cursor out of a region you specify in the `mouseRgn` parameter to the `WaitNextEvent` function. Then, when a mouse-moved event is detected in your main event loop, you can use `SetCursor`, `SetCCursor`, or `SetThemeCursor`, to change the cursor to the appropriate shape.

## Changing Cursor Shape in Response to Resume Events

Your application also needs to set the cursor shape in response to resume events, normally by setting the arrow cursor.

## Hiding Cursors

You can remove the cursor image from the screen using `HideCursor`. You can hide the cursor temporarily using `ObscureCursor` or you can hide the cursor in a given rectangle by using `ShieldCursor`. To display a hidden cursor, use `ShowCursor`. Note, however, that you do not need to explicitly show the cursor after your application uses `ObscureCursor` because the cursor automatically reappears when the user moves the mouse again.

## Animated Cursors—Mac OS 8/9

### Methodology 1

Mac OS 8.5 introduced a new function (`SetThemeAnimatedCursor`) for animating a specified cursor type. You must pass one of the following constants, which are of type `ThemeCursor`, in the `inCursor` parameter of `SetThemeAnimatedCursor`:

<i>Constant</i>	<i>Value</i>
<code>kThemeWatchCursor</code>	7
<code>kThemeCountingUpHandCursor</code>	11
<code>kThemeCountingDownHandCursor</code>	12
<code>kThemeCountingUpAndDownHandCursor</code>	13
<code>kThemeSpinningCursor</code>	14

### Methodology 2

Another methodology requires

- A series of 'CURS' (or 'crsr') resources that make up the “frames” of the animation.
- An 'acur' resource, which collects and orders the 'CURS' frames into a single animation, specifying the IDs of the resources and the sequence for displaying them in the animation.

### System 'acur' and 'CURS' Resources

The system contains an 'acur' resource (ID -6079), together the associated eight 'CURS' resources, for an animated watch cursor. It also contains eight 'CURS' resources (IDs -20701 to -20708) for an animated spinning (beach ball) cursor and six 'CURS' resources (IDs -20709 to -20714) for an animated counting hand cursor.

### Custom 'acur' and 'CURS' Resources

Fig 4 shows the structure of a compiled 'acur' resource, and an 'acur' resource and one of its associated 'CURS' resources being created using Resorcerer.

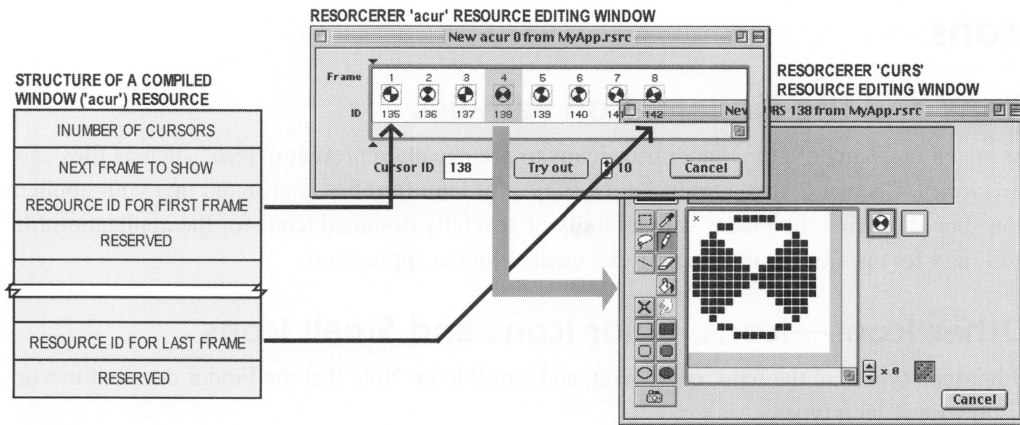


FIG 4 - CREATING AN 'acur' RESOURCE AND ASSOCIATED 'CURS' RESOURCES USING RESORCERER

## Creating the Animated Cursor

The following are the steps required to create the animated cursor:

- If you do not intend to use the system-supplied 'acur' and associated 'CURS' resources
  - Create a series of 'CURS' resources that make up the “frames” of the animation
  - Create an 'acur' resource
- Load the 'acur' resource into a structure which replicates the structure of an 'acur' resource, for example
 

```
typedef struct
{
    short    numberOfFrames;
    short    whichFrame;
    CursHandle frame[];
} animCurs, *animCursPtr, **animCursHandle;
```
- Load the 'CURS' resources using GetCursor and assign handles to the resulting Cursor structures to the elements of the frame field.
- At the desired interval, call SetCursor to display each cursor, that is, each “frame,” in rapid succession, returning to the first frame after the last frame has been displayed.

## Animated Cursor—Mac OS X

When the Mac OS X wait cursor appears automatically, it means that the application has stopped calling an event handling API for more than a certain period of time (about two seconds).

Your application can also turn the wait cursor on and off using the QuickDraw function QDDisplayWaitCursor. Passing true in the forceWaitCursor parameter turns the cursor on and passing false resumes automatic operation. The function keeps track of nested calls.

## Icons

### Icons and the Finder—Icon Families

As stated in Chapter 9, the Finder uses **icons** to graphically represent objects, such as files and directories. Chapter 9 also introduced the subject of **icon families**, and stated that your application should provide the Finder with a family of specially designed icons for the application file itself and for each of the document types created by the application.

### Other Icons—Icons, Color Icons and Small Icons

Other icon types are the **icon**, **color icon**, and **small icon**. Note that the Finder does not use or display these icon types.

#### Icon ('ICON')

The icon is a black-and-white icon defined in an 'ICON' resource, which contains a 32-by-32 pixel bit map. Icons do not need a mask because they are always displayed on a white background.

#### Color Icon ('cicn')

The color icon is defined in a 'cicn' resource, which includes a pixel map, a bit map, and a mask. You can use a 'cicn' resource to define a color icon with any width and height and with a bit depth up to 8. Fig 5 shows an 8-bit 32-by 32-pixel 'cicn' resource being created using Resorcerer.

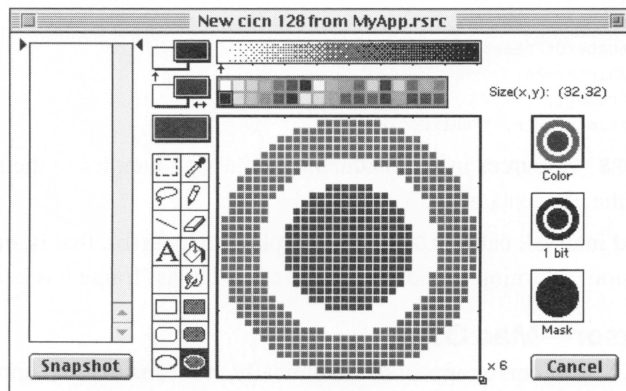


FIG 5 - CREATING AN 8-BIT 32 BY 32 PIXEL 'cicn' RESOURCE USING RESORCERER

## Small Icon ('SICN')

The small icon is a black-and-white icon defined in a 'SICN' resource. Small icons are 12 by 16 pixels even though they are stored in a resource as 16-by-16 pixel bitmaps. Small icons are of doubtful utility in the Carbon era and will not be considered further.

## Icons in Windows, Menus, and Alerts and Dialogs

The icons provided by your application for the Finder (or the default system-supplied icons used by the Finder if your application does not provide its own icons) are displayed on the desktop. Your application can also display icons in its menus, dialogs and windows.

### Icons in Windows

You can display icons of any kind in your windows using the appropriate Icon Utilities functions.

### Icons in Menus

The Menu Manager allows you to display icons of resource types 'ICON' (icon) and 'cicn' (color icon) in menu items. The procedure is as follows:

- Create the icon resource with a resource ID between 257 and 511. Subtract 256 from the resource ID to get a value called the **icon number**. Specify the icon number in the Icon field of the menu item definition.
- For an icon ('ICON'), specify 0x1D in the keyboard equivalent field of the menu item definition to indicate to the Menu Manager that the icon should be reduced to fit into a 16-by-16 pixel rectangle. Otherwise, specify a value of 0x00, or a value greater than 0x20, in the keyboard equivalent field to cause the Menu Manager to expand the item's rectangle so as to display the icon at its normal 32-by-32 pixel size. (A value greater than 0x20 in the keyboard equivalent field specifies the item's Command-key equivalent.)
- For a color icon ('cicn'), specify 0x00 or a value greater than 0x20 in the keyboard equivalent field of the menu item definition. The Menu Manager automatically enlarges the enclosing rectangle of the menu item according to the rectangle specified in the 'cicn' resource. (Color icons, unlike icons, can be any height or width.)

When the menu is displayed, the Menu Manager first looks for a 'cicn' resource with the resource ID calculated from the icon number and displays that icon if it is found. If a 'cicn' resource is not found, the Menu Manager searches for an 'ICON' resource and plots it in either a 32-by-32 pixel rectangle or a 16-by-16 bit rectangle, depending on the value in the menu item's keyboard equivalent field.



## Icons in Alerts and Dialogs

The Dialog Manager allows you to display icons of resource types 'ICON' (icon) and 'cicn' (color icon) in Mac OS 8/9 alerts and in dialogs. You can display the icon alone or within an image well.

To display the icon alone, the procedure is to define an item of type Icon and provide the resource ID of the icon in the item list ('DITL') resource for the dialog. This will cause the Dialog Manager to automatically display the icon whenever you display the alert or dialog using Dialog Manager functions.

To display the icon within an image well, include an image well control in the alert or dialog's item list and assign the resource ID of the icon to the control's minimum value field.

If you provide a color icon ('cicn') resource with the same resource ID as an icon ('ICON') resource, the Dialog Manager displays the color icon instead of the black-and-white icon.

On Mac OS 8/9, you would ordinarily use the `Alert` function (which does not automatically draw a system-supplied alert icon in the alert), or the `StandardAlert` function with `kAlertPlainAlert` passed in the `inAlertType` parameter, when you wish to display an alert containing your own icon (for example, in your application's About... alert). If you invoke an alert using the `NoteAlert`, `CautionAlert`, or `StopAlert` functions, or with the `StandardAlert` function with an alert type constant of other than `kAlertPlainAlert` passed in the `inAlertType` parameter, the Dialog Manager draws the system-supplied icon as well as your icon. Since your icon is drawn last, you can obscure the system-supplied icon by positioning your icon at the same coordinates.

## Drawing and Manipulating Icons

The Icon Utilities allow your application (and the system software) to draw and manipulate icons of any standard resource type in windows and, subject to the limitations and requirements previously described, in menus and dialogs.

You need to use Icon Utilities functions only if:

- You wish to draw icons in your application's windows.
- You wish to draw icons which are not recognized by the Menu Manager and the Dialog Manager in, respectively, menu items and dialogs.

## Preamble—Icon Families and Icon Suites

### Icon Families

You can define individual icons of resource types 'ICON' and 'cicn' that are not part of an icon family and use Icon Utilities functions to draw them as required. However, to display an icon effectively at a variety of sizes and bit depths, you should provide an icon family in the

same way that you provide icon families for the Finder. The advantage of providing an icon family is that you can then leave it to functions such as `PlotIconID`, which are used to draw icons, to automatically determine which icon in the icon family is best suited to the specified destination rectangle and current display bit depth.

### Icon Suites

Some Icon Utilities functions take as a parameter a handle to an **icon suite**. Typically, an icon suite is comprised of one or more handles to icon resources from a single icon family which have been read into memory. The `GetIconSuite` function may be used to get a handle to an icon suite, which can then be passed to functions such as `PlotIconSuite` to draw that icon in the icon suite best suited to the destination rectangle and current display bit depth.

An icon suite can contain handles to all of the six icon resources that an icon family can contain. Alternatively, it can contain handles to only a subset of those resources.

When you create an icon suite from icon family resources, the associated resource file should remain open while you use Icon Utilities functions.

### Drawing an Icon Directly from a Resource

To draw an icon from an icon family without first creating an icon suite, use the `PlotIconID` function. `PlotIconID` determines, from the size of the specified destination rectangle and the current bit depth of the display device, which icon to draw. The icon drawn is as follows:

<i>Destination Rectangle Size</i>	<i>Icon Drawn</i>
Width or height greater than or equal to 32	The 32-by-32 pixel icon with the appropriate bit depth
Less than 32 by 32 pixels bit depth	The 16-by-16 pixel icon with the appropriate

### Icon Stretching and Shrinking

`PlotIconID` may stretch or shrink the icon to fit depending on the size of the destination rectangle. To draw icons without stretching them, `PlotIconID` requires that the destination rectangle have the same dimensions as one of the standard icons.

### Icon Alignment and Transform

In addition to destination rectangle and resource ID parameters, `PlotIconID` takes **alignment** and **transform** parameters. Icon Utilities functions can automatically align an icon within its destination rectangle. (For example, an icon which is taller than it is wide can be aligned to either the right or left of its destination rectangle.) These functions can also transform the appearance of the icon in standard ways analogous to Finder states for icons.

Variables of type `IconAlignmentType` and `IconTransformType` should be declared and assigned values representing alignment and transform requirements. Constants, such as `kAlignAbsoluteCenter` and `kTransformNone`, are available to specify alignment and transform requirements.

## Getting an Icon Suite and Drawing One of Its Icons

The `GetIconSuite` function, with the constant `kSelectorAllAvailableData` passed in the third parameter, is used to get all icons from an icon family with a specified resource ID and to collect the handles to the data for each icon into an icon suite. An icon from this suite may then be drawn using `PlotIconSuite` which, like `PlotIconID`, takes destination rectangle, alignment and transform parameters and stretches or shrinks the icon if necessary.

## Drawing Specific Icons from an Icon Family

If you need to plot a specific icon from an icon family rather than use the Icon Utilities to automatically select a family member, you must first create an icon suite that contains only the icon of the desired resource type together with its corresponding mask. Constants such as `kSelectorLarge4Bit` (an icon selector mask for an 'ic14' icon) are used as the third parameter of the `GetIconSuite` call to retrieve the required family member. You can then use `PlotIconSuite` to plot the icon.

## Drawing Icons That Are Not Part of an Icon Family

To draw icons of resource type 'ICON' and 'cicn' in menu items and dialogs, you use Menu Manager and Dialog Manager functions such as `SetItemIcon` and `SetDialogItem`.

To draw resources of resource type 'ICON' and 'cicn' in your application's windows, you use the following functions:

<i>Resource Type</i>	<i>Function to Get Icon</i>	<i>Functions to Draw Icon</i>
'ICON'	<code>GetIcon</code>	<code>PlotIconHandle</code> <code>PlotIcon</code>
'cicn'	<code>GetCIcon</code>	<code>PlotCIconHandle</code> <code>PlotCIcon</code>

The functions in this list ending in `Handle` allow you to specify alignment and transforms for the icon.

## Manipulating Icons

The `GetIconFromSuite` function may be used to get a handle to the pixel data for a specific icon from an icon suite. You can then use this handle to manipulate the icon data, for example, to alter its color or add three-dimensional shading.

The Icon Utilities also include functions that allow you to perform an action on one or more icons in an icon suite and to perform hit testing on icons.

## Main Constants, Data Types and Functions— Offscreen Graphics Worlds

### Constants

#### Flags for `GWorldFlags` Parameter

```
pixPurgeBit      = 0  Set to make base address for offscreen pixel image purgeable.
noNewDeviceBit   = 1  Set to not create a new GDevice structure for offscreen world.
pixelsPurgeableBit = 6  Set to make base address for pixel image purgeable.
pixelsLockedBit  = 7  Set to lock base address for offscreen pixel image.
```

### Data Types

```
typedef CGrafPtr      GWorldPtr;
typedef unsigned long GWorldFlags;
```

### Functions

#### Creating, Altering, and Disposing of Offscreen Graphics Worlds

```
QDErr      NewGWorld(GWorldPtr *offscreenGWorld, short PixelDepth,
                    const Rect *boundsRect, CTabHandle cTable, GDHandle aGDevice, GWorldFlags flags);
GWorldFlags UpdateGWorld(GWorldPtr *offscreenGWorld, short pixelDepth,
                    const Rect *boundsRect, CTabHandle cTable, GDHandle aGDevice, GWorldFlags flags);
void        DisposeGWorld(GWorldPtr offscreenGWorld);
```

#### Saving and Restoring Graphics Ports and Offscreen Graphics Worlds

```
void        GetGWorld(CGrafPtr *port, GDHandle *gdh);
void        SetGWorld(CGrafPtr port, GDHandle gdh);
```

#### Managing an Offscreen Graphics World's Pixel Image

```
PixMapHandle GetGWorldPixMap(GWorldPtr offscreenGWorld);
Boolean      LockPixels(PixMapHandle pm);
void         UnlockPixels(PixMapHandle pm);
void         AllowPurgePixels(PixMapHandle pm);
void         NoPurgePixels(PixMapHandle pm);
GWorldFlags  GetPixelsState(PixMapHandle pm);
void         SetPixelsState(PixMapHandle pm, GWorldFlags state);
Ptr          GetPixBaseAddr(PixMapHandle pm);
Boolean      PixMap32Bit(PixMapHandle pmHandle);
```

# Main Constants, Data Types and Functions— Pictures

## Constants

### Verbs for the GetPictInfo, GetPixMapInfo, and NewPictInfo calls

returnColorTable	= 0x0001	Return a ColorTable structure.
returnPalette	= 0x0002	Return a Palette structure.
recordComments	= 0x0004	Return comment information.
recordFontInfo	= 0x0008	Return font information.
suppressBlackAndWhite	= 0x0010	Do not include black and white.

### Color Pick Methods for the GetPictInfo, GetPixMapInfo, and NewPictInfo calls

systemMethod	= 0	System color pick method.
popularMethod	= 1	Most popular set of colors.
medianMethod	= 2	A good average mix of colors.

## Data Types

### Picture

```
struct Picture
{
    short picSize;    // For a version 1 picture: its size.
    Rect picFrame;    // Bounding rectangle for the picture
};
typedef struct Picture Picture;
typedef Picture *PicPtr;
typedef PicPtr *PicHandle;
```

### OpenCPicParams

```
struct OpenCPicParams
{
    Rect srcRect;    // Optimal bounding rectangle.
    Fixed hRes;      // Best horizontal resolution.
    Fixed vRes;      // Best vertical resolution.
    short version;    // Set to -2
    short reserved1;  // (Reserved. Set to 0.)
    long reserved2;   // (Reserved. Set to 0.)
};
typedef struct OpenCPicParams OpenCPicParams;
```

### PictInfo

```
struct PictInfo
{
    short version;    // This is always zero, for now.
    long uniqueColors; // Number of actual colors in the picture(s)/pixmap(s).
    PaletteHandle thePalette; // Handle to the palette information.
    CTabHandle theColorTable; // Handle to the color table.
    Fixed hRes;      // Maximum horizontal resolution for all the pixmaps.
    Fixed vRes;      // Maximum vertical resolution for all the pixmaps.
    short depth;     // Maximum depth for all the pixmaps (in the picture).
```

```

Rect          sourceRect;      // Picture frame rectangle (contains the entire picture).
long          textCount;       // Total number of text strings in the picture.
long          lineCount;       // Total number of lines in the picture.
long          rectCount;       // Total number of rectangles in the picture.
long          rRectCount;      // Total number of round rectangles in the picture.
long          ovalCount;       // Total number of ovals in the picture.
long          arcCount;        // Total number of arcs in the picture.
long          polyCount;       // Total number of polygons in the picture.
long          regionCount;     // Total number of regions in the picture.
long          bitMapCount;     // Total number of bitmaps in the picture.
long          pixMapCount;     // Total number of pixmaps in the picture.
long          commentCount;    // Total number of comments in the picture.
long          uniqueComments;  // The number of unique comments in the picture.
CommentSpecHandle commentHandle; // Handle to all the comment information.
long          uniqueFonts;     // The number of unique fonts in the picture.
FontSpecHandle fontHandle;     // Handle to the FontSpec information.
Handle        fontNamesHandle; // Handle to the font names.
long reserved1;
long reserved2;
};
typedef struct PictInfo PictInfo;
typedef PictInfo *PictInfoPtr;
typedef PictInfoPtr *PictInfoHandle;
    
```

## CommentSpec

```

struct CommentSpec
{
    short count;      // Number of occurrences of this comment ID.
    short ID;         // ID for the comment in the picture.
};
typedef struct CommentSpec CommentSpec;
typedef CommentSpec *CommentSpecPtr;
typedef CommentSpecPtr *CommentSpecHandle;
    
```

## FontSpec

```

struct FontSpec
{
    short pictFontID; // ID of the font in the picture.
    short sysFontID;  // ID of the same font in the current system file.
    long size[4];     // Bit array of all the sizes found (1..127) (bit 0 means > 127).
    short style;      // Combined style of all occurrences of the font.
    long nameOffset;  // Offset into the fontNamesHdl handle for the font's name.
};
typedef struct FontSpec FontSpec;
typedef FontSpec *FontSpecPtr;
typedef FontSpecPtr *FontSpecHandle;
    
```

# Functions

## Creating and Disposing of Pictures

```

PicHandle OpenCPicture(const OpenCPicParams *newHeader);
void PicComment(short kind, short dataSize, Handle dataHandle);
void ClosePicture(void);
void KillPicture(PicHandle myPicture);
    
```

## Drawing Pictures

```
void DrawPicture(PicHandle myPicture,const Rect *dstRect)
PicHandle GetPicture(Integer picID);
```

## Collecting Picture Information

```
OSErr GetPictInfo(PicHandle thePictHandle,PictInfo *thePictInfo,short verb,
short colorsRequested,short colorPickMethod,short version);
OSErr GetPixMapInfo(PixmapHandle thePixMapHandle,PictInfo *thePictInfo,short verb,
short colorsRequested,short colorPickMethod,short version);
OSErr NewPictInfo(PictInfoID *thePictInfoID,short verb,short colorsRequested,
short colorPickMethod,short version);
OSErr RecordPictInfo(PictInfoID thePictInfoID,PicHandle thePictHandle);
OSErr RecordPixMapInfo(PictInfoID thePictInfoID,PixmapHandle thePixMapHandle);
OSErr RetrievePictInfo(PictInfoID thePictInfoID,PictInfo *thePictInfo,
short colorsRequested);
OSErr DisposPictInfo(PictInfoID thePictInfoID);
```

# Main Constants, Data Types and Functions— Cursors

## Constants

```
iBeamCursor = 1
crossCursor = 2
plusCursor = 3
watchCursor = 4
```

## Data Types

### Cursor

```
struct Cursor
{
    Bits16 data;
    Bits16 mask;
    Point hotSpot;
};
typedef struct Cursor Cursor;
typedef Cursor *CursPtr;
typedef CursPtr *CursHandle;
```

### CCrsr

```
struct CCrsr
{
    short crsrType; // Type of cursor.
    PixmapHandle crsrMap; // The cursor's pixmap.
    Handle crsrData; // Cursor's data.
    Handle crsrXData; // Expanded cursor data.
    short crsrXValid; // Depth of expanded data (0 if none).
```



```

Handle      crsrXHandle; // Future use.
Bits16      crsr1Data;   // One-bit cursor.
Bits16      crsrMask;    // Cursor's mask.
Point       crsrHotSpot; // Cursor's hotspot.
long        crsrXTable;  // Private.
long        crsrID;      // Private.
};
typedef struct CCrsr CCrsr;
typedef CCrsr *CCrsrPtr;
typedef CCrsrPtr *CCrsrHandle;
    
```

## Acur

```

struct Acur
{
    short      n;          // Number of cursors (frames).
    short      index;      // (Reserved.)
    short      frame1;     // 'CURS' resource ID for frame #1.
    short      fill1;      // (Reserved.)
    short      frame2;     // 'CURS' resource ID for frame #2.
    short      fill2;      // (Reserved.)
    short      frameN;     // 'CURS' resource ID for frame #n.
    short      fillN;      // (Reserved.)
};
typedef struct Acur acur, *acurPtr, **acurHandle;
    
```

## Functions

### Initializing Cursors

```

void      InitCursor(void);
void      InitCursorCtl(acurHandle newCursors);
    
```

### Changing Black-and-White Cursors

```

CursHandle GetCursor(short cursorID);
void      SetCursor(const Cursor *crsr);
    
```

### Changing Color Cursors

```

CCrsrHandle GetCCursor(short crsrID);
void      SetCCursor(CCrsrHandle cCrsr);
void      AllocCursor(void);
void      DisposCCursor(CCrsrHandle cCrsr);
void      DisposeCCursor(CCrsrHandle cCrsr);
    
```

### Hiding, Showing, and Animating Cursors

```

void      HideCursor(void);
void      ShowCursor(void);
void      ObscureCursor(void);
void      ShieldCursor(const Rect *shieldRect, Point offsetPt);
void      RotateCursor(long counter);
pascal   void SpinCursor(short increment);
    
```

## Appearance Manager Constants, Data Types and Functions—Cursors

### Constants

KThemeArrowCursor	= 0	
KThemeCopyArrowCursor	= 1	
KThemeAliasArrowCursor	= 2	
KThemeContextualMenuArrowCursor	= 3	
KThemeIBeamCursor	= 4	
KThemeCrossCursor	= 5	
KThemePlusCursor	= 6	
KThemeWatchCursor	= 7	Can animate
KThemeClosedHandCursor	= 8	
KThemeOpenHandCursor	= 9	
KThemePointingHandCursor	= 10	
KThemeCountingUpHandCursor	= 11	Can animate
KThemeCountingDownHandCursor	= 12	Can animate
KThemeCountingUpAndDownHandCursor	= 13	Can animate
KThemeSpinningCursor	= 14	Can Animate
KThemeResizeLeftCursor	= 15	
KThemeResizeRightCursor	= 16	
KThemeResizeLeftRightCursor	= 17	

### Data Types

```
typedef UInt32 ThemeCursor;
```

### Functions

```
OSStatus SetThemeCursor(ThemeCursor inCursor);
OSStatus SetAnimatedThemeCursor(ThemeCursor inCursor, UInt32 inAnimationStep);
```

#### Mac OS X Only

```
void QDDisplayWaitCursor(Boolean forceWaitCursor);
```

## Main Constants, Data Types and Functions—Icons

### Constants

#### Types for Icon Families

kLarge1BitMask	= FOUR_CHAR_CODE('ICN#')
kLarge4BitData	= FOUR_CHAR_CODE('ic14')
kLarge8BitData	= FOUR_CHAR_CODE('ic18')
kSmall1BitMask	= FOUR_CHAR_CODE('ics#')
kSmall4BitData	= FOUR_CHAR_CODE('ics4')
kSmall8BitData	= FOUR_CHAR_CODE('ics8')
kMini1BitMask	= FOUR_CHAR_CODE('icm#')
kMini4BitData	= FOUR_CHAR_CODE('icm4')
kMini8BitData	= FOUR_CHAR_CODE('icm8')

**IconAlignmentType Values**

kAlignNone	=	0x00	
kAlignVerticalCenter	=	0x01	
kAlignTop	=	0x02	
kAlignBottom	=	0x03	
kAlignHorizontalCenter	=	0x04	
kAlignAbsoluteCenter	=	kAlignVerticalCenter	kAlignHorizontalCenter
kAlignCenterTop	=	kAlignTop	kAlignHorizontalCenter
kAlignCenterBottom	=	kAlignBottom	kAlignHorizontalCenter
kAlignLeft	=	0x08	
kAlignCenterLeft	=	kAlignVerticalCenter	kAlignLeft
kAlignTopLeft	=	kAlignTop	kAlignLeft
kAlignBottomLeft	=	kAlignBottom	kAlignLeft
kAlignRight	=	0x0C	
kAlignCenterRight	=	kAlignVerticalCenter	kAlignRight
kAlignTopRight	=	kAlignTop	kAlignRight
kAlignBottomRight	=	kAlignBottom	kAlignRight

**IconTransformType Values**

kTransformNone	=	0x00	
kTransformDisabled	=	0x01	
kTransformOffline	=	0x02	
kTransformOpen	=	0x03	
kTransformLabel1	=	0x0100	
kTransformLabel2	=	0x0200	
kTransformLabel3	=	0x0300	
kTransformLabel4	=	0x0400	
kTransformLabel5	=	0x0500	
kTransformLabel6	=	0x0600	
kTransformLabel7	=	0x0700	
kTransformSelected	=	0x4000	
kTransformSelectedDisabled	=	kTransformSelected	kTransformDisabled
kTransformSelectedOffline	=	kTransformSelected	kTransformOffline
kTransformSelectedOpen	=	kTransformSelected	kTransformOpen

**IconSelectorValue Masks**

kSelectorLarge1Bit	=	0x00000001	
kSelectorLarge4Bit	=	0x00000002	
kSelectorLarge8Bit	=	0x00000004	
kSelectorSmall1Bit	=	0x00000100	
kSelectorSmall4Bit	=	0x00000200	
kSelectorSmall8Bit	=	0x00000400	
kSelectorMini1Bit	=	0x00010000	
kSelectorMini4Bit	=	0x00020000	
kSelectorMini8Bit	=	0x00040000	
kSelectorAllLargeData	=	0x000000FF	
kSelectorAllSmallData	=	0x0000FF00	
kSelectorAllMiniData	=	0x00FF0000	
kSelectorAll1BitData	=	kSelectorLarge1Bit	kSelectorSmall1Bit   kSelectorMini1Bit
kSelectorAll4BitData	=	kSelectorLarge4Bit	kSelectorSmall4Bit   kSelectorMini4Bit
kSelectorAll8BitData	=	kSelectorLarge8Bit	kSelectorSmall8Bit   kSelectorMini8Bit
kSelectorAllAvailableData	=	(long)0xFFFFFFFF	

## Data Types

```
typedef short   IconAlignmentType;
typedef short   IconTransformType;
typedef UInt32  IconSelectorValue;
typedef Handle  IconSuiteRef;
typedef Handle  IconCacheRef;
```

### CIcon

```
struct CIcon
{
    PixMap iconPMap;          // Icon's pixMap.
    BitMap iconMask;          // Icon's mask.
    BitMap iconBMap;          // Icon's bitMap.
    Handle iconData;          // Icon's data.
    short iconMaskData[1];    // Icon's mask and BitMap data.
};
typedef struct CIcon CIcon;
typedef CIcon *CIconPtr;
typedef CIconPtr *CIconHandle;
```

## Functions

### Drawing Icons from Resources

```
OSErr PlotIconID(const Rect *theRect, IconAlignmentType align, IconTransformType transform,
                 short theResID);
void PlotIcon(const Rect *theRect, Handle theIcon);
OSErr PlotIconHandle(const Rect *theRect, IconAlignmentType align,
                    IconTransformType transform, Handle theIcon);
void PlotCIcon(const Rect *theRect, CIconHandle theIcon);
OSErr PlotCIconHandle(const Rect *theRect, IconAlignmentType align,
                    IconTransformType transform, CIconHandle theIcon);
OSErr PlotSICNHandle(const Rect *theRect, IconAlignmentType align,
                    IconTransformType transform, Handle theSICN);
```

### Getting Icons from Resources Which Do Not Belong to an Icon Family

```
Handle GetIcon(short iconID);
CIconHandle GetCIcon(short iconID);
```

### Disposing of Icons

```
OSErr DisposeCIcon(CIconHandle theIcon);
```

### Creating an Icon Suite

```
OSErr GetIconSuite(Handle *theIconSuite, short theResID, IconSelectorValue selector);
OSErr NewIconSuite(Handle *theIconSuite);
OSErr AddIconToSuite(Handle theIconData, Handle theSuite, ResType theType);
```

### Getting Icons from an Icon Suite

```
OSErr GetIconFromSuite(Handle *theIconData, Handle theSuite, ResType theType);
```

## Drawing Icons from an Icon Suite

```
OSErr PlotIconSuite(const Rect *theRect, IconAlignmentType align,
    IconTransformType transform, Handle theIconSuite);
```

## Performing Operations on Icons in an Icon Suite

```
OSErr ForEachIconDo(Handle theSuite, IconSelectorValue selector, IconActionUPP action,
    void *yourDataPtr);
```

## Disposing of Icon Suites

```
OSErr DisposeIconSuite(Handle theIconSuite, Boolean disposeData);
```

## Converting an Icon Mask to a Region

```
OSErr IconSuiteToRgn(RgnHandle theRgn, const Rect *iconRect,
    IconAlignmentType align, Handle theIconSuite);
OSErr IconIDToRegion(RgnHandle theRgn, const Rect *iconRect,
    IconAlignmentType align, short iconID);
```

## Determining Whether a Point or Rectangle Is Within an Icon

```
Boolean PtInIconSuite(Point testPt, const Rect *iconRect, IconAlignmentType align,
    Handle theIconSuite);
Boolean PtInIconID(Point testPt, const Rect *iconRect, IconAlignmentType align,
    short iconID);
Boolean RectInIconSuite(const Rect *testRect, const Rect *iconRect, IconAlignmentType align,
    Handle theIconSuite);
Boolean RectInIconID(const Rect *testRect, const Rect *iconRect, IconAlignmentType align,
    short iconID);
```

## Working with Icon Caches

```
OSErr MakeIconCache(Handle *theHandle, IconGetterProcPtr makeIcon, void *yourDataPtr);
OSErr LoadIconCache(const Rect *theRect, IconAlignmentType align,
    IconTransformType transform, Handle theIconCache);
```

# Demonstration Program GworldPicCursIcon Listing

```
// *****
// GWorldPicCursIcon.c CLASSIC EVENT MODEL
// *****
//
// This program demonstrates offscreen graphics world, picture, cursor, cursor shape change,
// animated cursor, and icon operations as a result of the user choosing items from a
// Demonstration menu. It also demonstrates a modal dialog-based About... box containing a
// picture.
//
// To keep the non-demonstration code to a minimum, the program contains no functions for
// updating the window or for responding to activate and operating system events.
//
// The program utilizes the following resources:
//
// • A 'plst' resource.
//
// • An 'MBAR' resource and associated 'MENU' resources (preload, non-purgeable).
```

```

// · A 'WIND' resource (purgeable) (initially visible).
//
// · An 'acur' resource (purgeable).
//
// · 'CURS' resources associated with the 'acur' resource (preload, purgeable).
//
// · Two 'cicn' resources (purgeable), one for the Icons menu item and one for drawing in the
//   window.
//
// · Two icon family resources (purgeable), both for drawing in the window.
//
// · A 'DLOG' resource (purgeable) and an associated 'DITL' resource (purgeable) and 'PICT'
//   resource for an About GWorldPicCursIcon... dialog box.
//
// · A 'STR#' resource (purgeable) containing transform constants.
//
// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenubar          128
#define rWindow           128
#define mAppleApplication 128
#define iAbout            1
#define mFile             129
#define iQuit             12
#define mDemonstration    131
#define iOffScreenGWorld1 1
#define iOffScreenGWorld2 2
#define iPicture           3
#define iCursor           4
#define iAnimatedCursor1  5
#define iAnimatedCursor2  6
#define iAnimatedCursorOSX 7
#define iIcon             8
#define rBeachBallCursor  128
#define rPicture          128
#define rTransformStrings 128
#define rIconFamily1      128
#define rIconFamily2      129
#define rColorIcon        128
#define rAboutDialog      128
#define kSleepTime        1
#define kBeachBallTickInterval 5
#define kCountingHandTickInterval 30
#define MAX_UINT32        0xFFFFFFFF
#define topLeft(r)         (((Point *) &(r))[0])
#define botRight(r)        (((Point *) &(r))[1])

```

```
// ..... typedefs

typedef struct
{
    Sint16    numberOfFrames;
    Sint16    whichFrame;
    CursHandle frame[];
} animCurs, *animCursPtr, **animCursHandle;

// ..... global variables

Boolean      gRunningOnX = false;
WindowRef    gWindowRef;
Boolean      gDone;
Sint32       gSleepTime;
RgnHandle    gCursorRegion;
Boolean      gCursorRegionsActive = false;
Boolean      gAnimatedCursor1Active = false;
Boolean      gAnimatedCursor2Active = false;
Boolean      gAnimatedCursorOSXActive = false;
animCursHandle gAnimCursHdl;
Sint16       gAnimCursTickInterval;
Sint32       gAnimCursLastTick;
RGBColor     gBlackColor = { 0x0000, 0x0000, 0x0000 };
RGBColor     gWhiteColor = { 0xFFFF, 0xFFFF, 0xFFFF };
RGBColor     gBeigeColor = { 0xF000, 0xE300, 0xC200 };
RGBColor     gBlueColor  = { 0x4444, 0x4444, 0x9999 };

// ..... function prototypes

void    main                (void);
void    doPreliminaries     (void);
OSErr   quitAppEventHandler (AppleEvent *,AppleEvent *,Sint32);
void    eventLoop           (void);
void    doIdle               (void);
void    doEvents             (EventRecord *);
void    doMenuChoice         (Sint32);
void    doOffScreenGWorld1   (void);
void    doOffScreenGWorld2   (void);
void    doPicture            (void);
void    doCursor             (void);
void    doChangeCursor       (WindowRef,RgnHandle);
void    doAnimatedCursor1    (void);
void    doAnimatedCursor2    (void);
Boolean doGetAnimCursor      (Sint16,Sint16);
void    doIncrementAnimCursor (void);
void    doReleaseAnimCursor   (void);
void    doAnimatedCursorOSX   (void);
void    doIcon                (void);
void    doAboutDialog         (void);
void    doDrawStuff           (void);
UInt16  doRandomNumber       (UInt16,UInt16);
```



```
// ***** main

void main(void)
{
    UInt32      seconds;
    MenuBarHandle menubarHdl;
    SInt32      response;
    MenuRef      menuRef;

    // ..... initialize managers

    doPreliminaries();

    // ..... seed random number generator

    GetDateTime(&seconds);
    SetQDGlobalsRandomSeed(seconds);

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMenubar);
    if(menubarHdl == NULL)
        ExitToShell();
    SetMenuBar(menubarHdl);
    DrawMenuBar();

    Gestalt(gestaltMenuMgrAttr,&response);
    if(response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
        {
            DeleteMenuItem(menuRef,iQuit);
            DeleteMenuItem(menuRef,iQuit - 1);
            DisableMenuItem(menuRef,0);
        }

        menuRef = GetMenuRef(mDemonstration);
        if(menuRef != NULL)
            EnableMenuItem(menuRef,iAnimatedCursorOSX);

        gRunningOnX = true;
    }

    // ..... open window

    if(!(gWindowRef = GetNewCWindow(rWindow,NULL,(WindowRef)-1)))
        ExitToShell();

    SetPortWindowPort(gWindowRef);
    TextSize(10);
}
```

```
// ..... enter event loop

eventLoop();
}

// ***** do preliminaries

void doPreliminaries(void)
{
    OSErr osError;

    MoreMasterPointers(64);
    InitCursor();
    FlushEvents(everyEvent,0);

    osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
                                   NewAEventHandlerUPP((AEventHandlerProcPtr) quitAppEventHandler),
                                   0L,false);

    if(osError != noErr)
        ExitToShell();
}

// ***** doQuitAppEvent

OSErr quitAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,SInt32 handlerRefcon)
{
    OSErr    osError;
    DescType returnedType;
    Size     actualSize;

    osError = AEGetAttributePtr(appEvent,keyMissedKeywordAttr,typeWildCard,&returnedType,NULL,0,
                                &actualSize);

    if(osError == errAEDescNotFound)
    {
        gDone = true;
        osError = noErr;
    }
    else if(osError == noErr)
        osError = errAEParamMissed;

    return osError;
}

// ***** eventLoop

void eventLoop(void)
{
    EventRecord eventStructure;
    Boolean     gotEvent;

    gDone = false;
    gSleepTime = MAX_UINT32;
    gCursorRegion = NULL;
```

```

while(!gDone)
{
    gotEvent = WaitNextEvent(everyEvent,&eventStructure,gSleepTime,gCursorRegion);
    if(gotEvent)
        doEvents(&eventStructure);
    else
    {
        if(eventStructure.what == nullEvent)
            doIdle();
    }
}
}

// ***** doIdle

void doIdle(void)
{
    if(gAnimatedCursor1Active || gAnimatedCursor2Active)
        doIncrementAnimCursor();
}

// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    WindowRef    windowRef;
    WindowPartCode partCode;

    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEProcessAppleEvent(eventStrucPtr);
            break;

        case mouseDown:
            partCode = FindWindow(eventStrucPtr->where,&windowRef);
            switch(partCode)
            {
                case inMenuBar:
                    doMenuChoice(MenuSelect(eventStrucPtr->where));
                    break;

                case inContent:
                    if(windowRef != FrontWindow())
                        SelectWindow(windowRef);
                    break;

                case inDrag:
                    DragWindow(windowRef,eventStrucPtr->where,NULL);
                    if(gCursorRegionsActive)
                        doChangeCursor(windowRef,gCursorRegion);
                    break;
            }
            break;
    }
}

```

```

case keyDown:
    if((eventStrucPtr->modifiers & cmdKey) != 0)
        doMenuChoice(MenuEvent(eventStrucPtr));
    break;

case updateEvt:
    BeginUpdate((WindowRef) eventStrucPtr->message);
    EndUpdate((WindowRef) eventStrucPtr->message);
    break;

case osEvt:
    switch((eventStrucPtr->message >> 24) & 0x000000FF)
    {
        case suspendResumeMessage:
            if((eventStrucPtr->message & resumeFlag) == 1)
                SetThemeCursor(kThemeArrowCursor);
            break;

        case mouseMovedMessage:
            if(gCursorRegionsActive)
                doChangeCursor(FrontWindow(),gCursorRegion);
            break;
    }
    break;
}
}

// ***** doMenuChoice

void doMenuChoice(SInt32 menuChoice)
{
    MenuID      menuID;
    MenuItemIndex menuItem;

    menuID = HiWord(menuChoice);
    menuItem = LoWord(menuChoice);

    if(menuID == 0)
        return;

    if(gAnimatedCursor1Active || gAnimatedCursor2Active)
    {
        if(gAnimatedCursor2Active)
            doReleaseAnimCursor();

        SetThemeCursor(kThemeArrowCursor);
        gSleepTime = MAX_UINT32;

        gAnimatedCursor1Active = false;
        gAnimatedCursor2Active = false;
    }

    if(gAnimatedCursorOSXActive)
        doAnimatedCursorOSX();
}

```

```
if(gCursorRegionsActive == true)
{
    gCursorRegionsActive = false;
    DisposeRgn(gCursorRegion);
    gCursorRegion = NULL;
}

switch(menuID)
{
    case mAppleApplication:
        if(menuItem == iAbout)
            doAboutDialog();
        break;

    case mFile:
        if(menuItem == iQuit)
            gDone = true;
        break;

    case mDemonstration:
        switch(menuItem)
        {
            case iOffScreenGWorld1:
                doOffScreenGWorld1();
                break;

            case iOffScreenGWorld2:
                doOffScreenGWorld2();
                break;

            case iPicture:
                doPicture();
                break;

            case iCursor:
                doCursor();
                break;

            case iAnimatedCursor1:
                doAnimatedCursor1();
                break;

            case iAnimatedCursor2:
                doAnimatedCursor2();
                break;

            case iAnimatedCursorOSX:
                doAnimatedCursorOSX();
                break;

            case iIcon:
                doIcon();
                break;
        }
        break;
}
```

```

    HiliteMenu(0);
}

// ***** doOffScreenGWorld1

void doOffScreenGWorld1(void)
{
    Rect        portRect, sourceRect, destRect;
    GrafPtr      windowPortPtr;
    GDHandle      deviceHdl;
    QDErr        qdErr;
    GWorldPtr     gworldPortPtr;
    PixMapHandle  gworldPixMapHdl, windowPixMapHdl;
    Boolean       lockPixResult;

    // ..... draw in window

    SetWTitle(gWindowRef, "\pTime-consuming drawing operation");

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    doDrawStuff();

    if(!gRunningOnX)
        SetThemeCursor(kThemeArrowCursor);

    SetWTitle(gWindowRef, "\pClick mouse to repeat in offscreen graphics port");
    QDFlushPortBuffer(GetWindowPort(gWindowRef), NULL);

    while(!Button()) ;

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    GetWindowPortBounds(gWindowRef, &portRect);

    RGBBackColor(&gBlueColor);
    EraseRect(&portRect);
    RGBForeColor(&gWhiteColor);
    MoveTo(190, 180);
    DrawString("\pPlease Wait. Drawing in offscreen graphics port.");

    // ..... draw in offscreen graphics port and copy to window

    // ..... save current graphics world and create offscreen graphics world

    GetGWorld(&windowPortPtr, &deviceHdl);

    qdErr = NewGWorld(&gworldPortPtr, 0, &portRect, NULL, NULL, 0);
    if(gworldPortPtr == NULL || qdErr != noErr)
    {
        SysBeep(10);
        return;
    }
}

```

```

SetGWorld(gworldPortPtr, NULL);

// ..... lock pixel image for duration of drawing and erase offscreen to white

gworldPixMapHdl = GetGWorldPixMap(gworldPortPtr);
if(!(lockPixResult = LockPixels(gworldPixMapHdl)))
{
    SysBeep(10);
    return;
}

EraseRect(&portRect);

// ..... draw into the offscreen graphics port

doDrawStuff();

// ..... restore saved graphics world

SetGWorld(windowPortPtr, deviceHdl);

// ..... set source and destination rectangles

GetPortBounds(gworldPortPtr, &sourceRect);
GetPortBounds(windowPortPtr, &destRect);

// ..... get window port's pixel map

windowPixMapHdl = GetGWorldPixMap(windowPortPtr);

// ..... ensure background color is white and foreground color in black, then copy

RGBBackColor(&gWhiteColor);
RGBForeColor(&gBlackColor);

CopyBits((BitMap *) *gworldPixMapHdl,
         (BitMap *) *windowPixMapHdl,
         &sourceRect, &destRect, srcCopy, NULL);

if(QDError() != noErr)
    SysBeep(10);

// ..... clean up

UnlockPixels(gworldPixMapHdl);
DisposeGWorld(gworldPortPtr);

if(!gRunningOnX)
    SetThemeCursor(kThemeArrowCursor);

SetWTitle(gWindowRef, "\\pOffscreen Graphics Worlds, Pictures, Cursors and Icons");
QDFlushPortBuffer(GetWindowPort(gWindowRef), NULL);
}

```



```
// ***** doOffScreenGWorld2

void doOffScreenGWorld2(void)
{
    PicHandle    picture1Hdl,picture2Hdl;
    Rect         portRect;
    Rect         sourceRect, maskRect, maskDisplayRect, dest1Rect, dest2Rect, destRect;
    GrafPtr      windowPortPtr;
    GDHandle      deviceHdl;
    QDErr        qdErr;
    GWorldPtr     gworldPortPtr;
    PixMapHandle  gworldPixMapHdl, windowPixMapHdl;
    RgnHandle     region1Hdl, region2Hdl, regionHdl;
    SInt16        a, sourceMode;

    RGBBackColor(&gBeigeColor);
    GetWindowPortBounds(gWindowRef,&portRect);
    EraseRect(&portRect);

    // ..... get the source picture and draw it in the window

    if(!(picture1Hdl = GetPicture(rPicture)))
        ExitToShell();
    HNoPurge((Handle) picture1Hdl);
    SetRect(&sourceRect,116,35,273,147);
    DrawPicture(picture1Hdl,&sourceRect);
    HPurge((Handle) picture1Hdl);
    MoveTo(116,32);
    DrawString("\pSource image");

    // ..... save current graphics world and create offscreen graphics world

    GetGWorld(&windowPortPtr,&deviceHdl);

    SetRect(&maskRect,0,0,157,112);

    qdErr = NewGWorld(&gworldPortPtr,0,&maskRect,NULL,NULL,0);
    if(gworldPortPtr == NULL || qdErr != noErr)
    {
        SysBeep(10);
        return;
    }

    SetGWorld(gworldPortPtr,NULL);

    // ..... lock pixel image for duration of drawing and erase offscreen to white

    gworldPixMapHdl = GetGWorldPixMap(gworldPortPtr);

    if(!(LockPixels(gworldPixMapHdl)))
    {
        SysBeep(10);
        return;
    }
}
```

```

GetPortBounds(gworldPortPtr,&portRect);
EraseRect(&portRect);

// ..... get mask picture and draw it in offscreen graphics port

if(!(picture2Hdl = GetPicture(rPicture + 1)))
    ExitToShell();
HNoPurge((Handle) picture2Hdl);
DrawPicture(picture2Hdl,&maskRect);

// ..... also draw it in the window

SetGWorld(windowPortPtr,deviceHdl);
SetRect(&maskDisplayRect,329,35,485,146);
DrawPicture(picture2Hdl,&maskDisplayRect);
HPurge((Handle) picture2Hdl);
MoveTo(329,32);
DrawString("\pCopy of offscreen mask");

// ..... define an oval-shaped region and a round rectangle-shaped region

SetRect(&dest1Rect,22,171,296,366);
region1Hdl = NewRgn();
OpenRgn();
FrameOval(&dest1Rect);
CloseRgn(region1Hdl);

SetRect(&dest2Rect,308,171,582,366);
region2Hdl = NewRgn();
OpenRgn();
FrameRoundRect(&dest2Rect,100,100);
CloseRgn(region2Hdl);

SetWTitle(GetWindowFromPort(windowPortPtr),"\pClick mouse to copy");
QDFlushPortBuffer(GetWindowPort(gWindowRef),NULL);
while(!Button()) ;

// ..... get window port's pixel map

windowPixMapHdl = GetGWorldPixMap(windowPortPtr);

// ..... set background and foreground color, then copy source to destination using mask

RGBForeColor(&gBlackColor);
RGBBackColor(&gWhiteColor);

for(a=0;a<2;a++)
{
    if(a == 0)
    {
        regionHdl = region1Hdl;
        destRect = dest1Rect;
        sourceMode = srcCopy;
        MoveTo(22,168);
    }

```

```

    DrawString("\pBoolean source mode srcCopy");
}
else
{
    regionHdl = region2Hdl;
    destRect = dest2Rect;
    sourceMode = srcXor;
    MoveTo(308,168);
    DrawString("\pBoolean source mode srcXor");
}

CopyDeepMask((BitMap *) *windowPixMapHdl,
              (BitMap *) *gworldPixMapHdl,
              (BitMap *) *windowPixMapHdl,
              &sourceRect,&maskRect,&destRect,sourceMode + ditherCopy,regionHdl);

if(QDError() != noErr)
    SysBeep(10);
}

// ..... clean up

UnlockPixels(gworldPixMapHdl);
DisposeGWorld(gworldPortPtr);

ReleaseResource((Handle) picture1Hdl);
ReleaseResource((Handle) picture2Hdl);
DisposeRgn(region1Hdl);
DisposeRgn(region2Hdl);

SetWTitle(gWindowRef,"\pOffscreen Graphics Worlds, Pictures, Cursors and Icons");
QDFlushPortBuffer(GetWindowPort(gWindowRef),NULL);
}

// ***** doPicture

void doPicture(void)
{
    Rect          portRect, pictureRect, theRect;
    OpenCpicParams picParams;
    RgnHandle     oldClipRgn;
    PicHandle     pictureHdl;
    SInt16        a, left, top, right, bottom, random;
    RGBColor      theColor;
    PictInfo      pictInfo;
    Str255        theString;

    RGBBackColor(&gWhiteColor);
    GetWindowPortBounds(gWindowRef,&portRect);
    EraseRect(&portRect);

```

```

// ..... define picture rectangle

pictureRect = portRect;
pictureRect.right = (portRect.right - portRect.left) / 2;
InsetRect(&pictureRect,10,10);

// ..... set clipping region

oldClipRgn = NewRgn();
GetClip(oldClipRgn);
ClipRect(&pictureRect);

// ..... set up OpenCpicParams structure

picParams.srcRect = pictureRect;
picParams.hRes = 0x00480000;
picParams.vRes = 0x00480000;
picParams.version = -2;

// ..... record picture

pictureHdl = OpenCPicture(&picParams);

RGBBackColor(&gBlueColor);
EraseRect(&pictureRect);

for(a=0;a<300;a++)
{
    theRect = pictureRect;

    theColor.red = doRandomNumber(0,65535);
    theColor.green = doRandomNumber(0,65535);
    theColor.blue = doRandomNumber(0,65535);
    RGBForeColor(&theColor);

    left = doRandomNumber(10,theRect.right);
    top = doRandomNumber(10,theRect.bottom);
    right = doRandomNumber(left,theRect.right);
    bottom = doRandomNumber(top,theRect.bottom);
    SetRect(&theRect,left,top,right,bottom);

    PenMode(doRandomNumber(addOver,adMin));

    random = doRandomNumber(0,5);

    if(random == 0)
    {
        MoveTo(left,top);
        LineTo(right - 1,bottom - 1);
    }
    else if(random == 1)
        PaintRect(&theRect);
    else if(random == 2)
        PaintRoundRect(&theRect,30,30);
}

```

```

else if(random == 3)
    PaintOval(&theRect);
else if(random == 4)
    PaintArc(&theRect,0,300);
else if(random == 5)
{
    TextSize(doRandomNumber(10,70));
    MoveTo(left,right);
    DrawString("\pPICTURE");
}
}

// ..... stop recording, draw picture, restore saved clipping region

ClosePicture();

DrawPicture(pictureHdl,&pictureRect);

SetClip(oldClipRgn);
DisposeRgn(oldClipRgn);

// ..... display some information from the PictInfo structure

RGBForeColor(&gBlueColor);
RGBBackColor(&gBeigeColor);
PenMode(patCopy);
OffsetRect(&pictureRect,300,0);
EraseRect(&pictureRect);
FrameRect(&pictureRect);
TextSize(10);

if(GetPictInfo(pictureHdl,&pictInfo,recordFontInfo + returnColorTable,1,systemMethod,0))
    SysBeep(10);

MoveTo(380,70);
DrawString("\pSome Picture Information:");

MoveTo(380,100);
DrawString("\pLines: ");
NumToString(pictInfo.lineCount,theString);
DrawString(theString);

MoveTo(380,115);
DrawString("\pRectangles: ");
NumToString((long) pictInfo.rectCount,theString);
DrawString(theString);

MoveTo(380,130);
DrawString("\pRound rectangles: ");
NumToString(pictInfo.rRectCount,theString);
DrawString(theString);

MoveTo(380,145);
DrawString("\pOvals: ");

```

```
NumToString(pictInfo.ovalCount,theString);
DrawString(theString);

MoveTo(380,160);
DrawString("\pArcs: ");
NumToString(pictInfo.arcCount,theString);
DrawString(theString);

MoveTo(380,175);
DrawString("\pPolygons: ");
NumToString(pictInfo.polyCount,theString);
DrawString(theString);

MoveTo(380,190);
DrawString("\pRegions: ");
NumToString(pictInfo.regionCount,theString);
DrawString(theString);

MoveTo(380,205);
DrawString("\pText strings: ");
NumToString(pictInfo.textCount,theString);
DrawString(theString);

MoveTo(380,220);
DrawString("\pUnique fonts: ");
NumToString(pictInfo.uniqueFonts,theString);
DrawString(theString);

MoveTo(380,235);
DrawString("\pUnique colors: ");
NumToString(pictInfo.uniqueColors,theString);
DrawString(theString);

MoveTo(380,250);
DrawString("\pFrame rectangle left: ");
NumToString(pictInfo.sourceRect.left,theString);
DrawString(theString);

MoveTo(380,265);
DrawString("\pFrame rectangle top: ");
NumToString(pictInfo.sourceRect.top,theString);
DrawString(theString);

MoveTo(380,280);
DrawString("\pFrame rectangle right: ");
NumToString(pictInfo.sourceRect.right,theString);
DrawString(theString);

MoveTo(380,295);
DrawString("\pFrame rectangle bottom: ");
NumToString(pictInfo.sourceRect.bottom,theString);
DrawString(theString);
```

```

QDFlushPortBuffer(GetWindowPort(gWindowRef),NULL);

// ..... release memory occupied by Picture structure

KillPicture(pictureHdl);
}

// ***** doCursor

void doCursor(void)
{
    Rect    portRect, cursorRect;
    SInt16 a;

    RGBBackColor(&gBlueColor);
    GetWindowPortBounds(gWindowRef,&portRect);
    EraseRect(&portRect);

    cursorRect = portRect;

    for(a=0;a<3;a++)
    {
        InsetRect(&cursorRect,40,40);

        if(a == 0 || a == 2)
            RGBBackColor(&gBeigeColor);
        else
            RGBBackColor(&gBlueColor);

        EraseRect(&cursorRect);
    }

    RGBForeColor(&gBeigeColor);
    MoveTo(10,20);
    DrawString("\pArrow cursor region");
    RGBForeColor(&gBlueColor);
    MoveTo(50,60);
    DrawString("\pIBeam cursor region");
    RGBForeColor(&gBeigeColor);
    MoveTo(90,100);
    DrawString("\pCross cursor region");
    RGBForeColor(&gBlueColor);
    MoveTo(130,140);
    DrawString("\pPlus cursor region");

    gCursorRegion = NewRgn();
    doChangeCursor(gWindowRef,gCursorRegion);

    gCursorRegionsActive = true;
}

```



```
// ***** doChangeCursor

void doChangeCursor(WindowRef windowRef,RgnHandle cursorRegion)
{
    RgnHandle arrowCursorRgn;
    RgnHandle ibeamCursorRgn;
    RgnHandle crossCursorRgn;
    RgnHandle plusCursorRgn;
    Rect      cursorRect;
    GrafPtr   oldPort;
    Point     mousePosition;

    arrowCursorRgn = NewRgn();
    ibeamCursorRgn = NewRgn();
    crossCursorRgn = NewRgn();
    plusCursorRgn  = NewRgn();

    SetRectRgn(arrowCursorRgn, -32768, -32768, 32766, 32766);

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    GetWindowPortBounds(windowRef, &cursorRect);
    LocalToGlobal(&topLeft(cursorRect));
    LocalToGlobal(&botRight(cursorRect));

    InsetRect(&cursorRect, 40, 40);
    RectRgn(beamCursorRgn, &cursorRect);
    DiffRgn(arrowCursorRgn, beamCursorRgn, arrowCursorRgn);

    InsetRect(&cursorRect, 40, 40);
    RectRgn(crossCursorRgn, &cursorRect);
    DiffRgn(beamCursorRgn, crossCursorRgn, beamCursorRgn);

    InsetRect(&cursorRect, 40, 40);
    RectRgn(plusCursorRgn, &cursorRect);
    DiffRgn(crossCursorRgn, plusCursorRgn, crossCursorRgn);

    GetGlobalMouse(&mousePosition);

    if(PtInRgn(mousePosition, beamCursorRgn))
    {
        SetThemeCursor(kThemeIBeamCursor);
        CopyRgn(beamCursorRgn, cursorRegion);
    }
    else if(PtInRgn(mousePosition, crossCursorRgn))
    {
        SetThemeCursor(kThemeCrossCursor);
        CopyRgn(crossCursorRgn, cursorRegion);
    }
    else if(PtInRgn(mousePosition, plusCursorRgn))
    {
        SetThemeCursor(kThemePlusCursor);
        CopyRgn(plusCursorRgn, cursorRegion);
    }
}
```

```

else
{
    SetThemeCursor(kThemeArrowCursor);
    CopyRgn(arrowCursorRgn,cursorRegion);
}

DisposeRgn(arrowCursorRgn);
DisposeRgn(ibeamCursorRgn);
DisposeRgn(crossCursorRgn);
DisposeRgn(plusCursorRgn);

SetPort(oldPort);
}

// ***** doAnimatedCursor1

void doAnimatedCursor1(void)
{
    Rect    portRect;
    Pattern whitePattern;

    BackColor(whiteColor);
    GetWindowPortBounds(gWindowRef,&portRect);
    FillRect(&portRect,GetQDGlobalsWhite(&whitePattern));

    gAnimCursTickInterval = kCountingHandTickInterval;
    gSleepTime = gAnimCursTickInterval;
    gAnimatedCursor1Active = true;
}

// ***** doAnimatedCursor2

void doAnimatedCursor2(void)
{
    Rect    portRect;
    Pattern whitePattern;
    SInt16  animCursResourceID, animCursTickInterval;

    BackColor(whiteColor);
    GetWindowPortBounds(gWindowRef,&portRect);
    FillRect(&portRect,GetQDGlobalsWhite(&whitePattern));

    animCursResourceID = rBeachBallCursor;
    animCursTickInterval = kBeachBallTickInterval;

    if(doGetAnimCursor(animCursResourceID,animCursTickInterval))
    {
        gSleepTime = animCursTickInterval;
        gAnimatedCursor2Active = true;
    }
    else
        SysBeep(10);
}

```

```
// ***** doGetAnimCursor

Boolean doGetAnimCursor(SInt16 resourceID,SInt16 tickInterval)
{
    SInt16 cursorID, a = 0;
    Boolean noError = false;

    if((gAnimCursHdl = (animCursHandle) GetResource('acur',resourceID)))
    {
        noError = true;
        while((a < (*gAnimCursHdl)->numberOfFrames) && noError)
        {
            cursorID = (SInt16) HiWord((SInt32) (*gAnimCursHdl)->frame[a]);
            (*gAnimCursHdl)->frame[a] = GetCursor(cursorID);
            if((*gAnimCursHdl)->frame[a])
                a++;
            else
                noError = false;
        }
    }

    if(noError)
    {
        gAnimCursTickInterval = tickInterval;
        gAnimCursLastTick = TickCount();
        (*gAnimCursHdl)->whichFrame = 0;
    }

    return noError;
}

// ***** doIncrementAnimCursor

void doIncrementAnimCursor(void)
{
    SInt32 newTick;
    static UInt32 animationStep;

    newTick = TickCount();
    if(newTick < (gAnimCursLastTick + gAnimCursTickInterval))
        return;

    if(gAnimatedCursor1Active)
    {
        SetAnimatedThemeCursor(kThemeCountingUpAndDownHandCursor,animationStep);
        animationStep++;
    }
    else if(gAnimatedCursor2Active)
    {
        SetCursor(*((*gAnimCursHdl)->frame[(*gAnimCursHdl)->whichFrame++]));
        if((*gAnimCursHdl)->whichFrame == (*gAnimCursHdl)->numberOfFrames)
            (*gAnimCursHdl)->whichFrame = 0;
    }
}
```

```

gAnimCursLastTick = newTick;
}

// ***** doReleaseAnimCursor

void doReleaseAnimCursor(void)
{
    SInt16 a;

    for(a=0;a<(*gAnimCursHdl)->numberOfFrames;a++)
        ReleaseResource((Handle) (*gAnimCursHdl)->frame[a]);

    ReleaseResource((Handle) gAnimCursHdl);
}

// ***** doAnimatedCursorOSX

void doAnimatedCursorOSX(void)
{
    if(!gAnimatedCursorOSXActive)
    {
        QDDisplayWaitCursor(true);
        gAnimatedCursorOSXActive = true;
    }
    else
    {
        QDDisplayWaitCursor(false);
        gAnimatedCursorOSXActive = false;
    }
}

// ***** doIcon

void doIcon(void)
{
    Rect          portRect, theRect;
    SInt16        a, b, stringIndex = 1;
    IconTransformType transform = 0;
    Str255        theString;
    Handle        iconSuiteHdl;
    CIconHandle    ciconHdl;

    RGBForeColor(&gBlueColor);
    RGBBackColor(&gBeigeColor);
    GetWindowPortBounds(gWindowRef,&portRect);
    EraseRect(&portRect);

    // ..... PlotIconID with transforms

    MoveTo(50,28);
    DrawString("\pPlotIconID with transforms");

```

```

for(a=50;a<471;a+=140)
{
    if(a == 190)
        transform = 16384;
    if(a == 330)
        transform = 256;

    for(b=0;b<4;b++)
    {
        if(a == 470 && b == 3)
            continue;

        GetIndString(theString,rTransformStrings,stringIndex++);
        MoveTo(a,b * 60 + 47);
        DrawString(theString);

        SetRect(&theRect,a,b * 60 + 50,a + 32,b * 60 + 82);
        PlotIconID(&theRect,0,transform,rIconFamily1);
        SetRect(&theRect,a + 40,b * 60 + 50,a + 56,b * 60 + 66);
        PlotIconID(&theRect,0,transform,rIconFamily1);
        SetRect(&theRect,a + 64,b * 60 + 50,a + 80,b * 60 + 62);
        PlotIconID(&theRect,0,transform,rIconFamily1);

        if(a >= 330)
            transform += 256;
        else
            transform ++;
    }
}

// ..... GetIconSuite and PlotIconSuite

MoveTo(50,275);
LineTo(550,275);
MoveTo(50,299);
DrawString("\pGetIconSuite and PlotIconSuite");

GetIconSuite(&iconSuiteHdl,rIconFamily2,kSelectorAllLargeData);

SetRect(&theRect,50,324,82,356);
PlotIconSuite(&theRect,kAlignNone,kTransformNone,iconSuiteHdl);
SetRect(&theRect,118,316,166,364);
PlotIconSuite(&theRect,kAlignNone,kTransformNone,iconSuiteHdl);
SetRect(&theRect,202,308,266,372);
PlotIconSuite(&theRect,kAlignNone,kTransformNone,iconSuiteHdl);

// ..... GetCIcon and PlotCIcon

MoveTo(330,299);
DrawString("\pGetCIcon and PlotCIcon");

ciconHdl = GetCIcon(rColorIcon);

```

```

SetRect(&theRect,330,324,362,356);
PlotCIcon(&theRect,ciconHdl);
SetRect(&theRect,398,316,446,364);
PlotCIcon(&theRect,ciconHdl);
SetRect(&theRect,482,308,546,372);
PlotCIcon(&theRect,ciconHdl);
}

// ***** doAboutDialog

void doAboutDialog(void)
{
    DialogPtr dialogPtr;
    SInt16 itemHit;

    dialogPtr = GetNewDialog(rAboutDialog,NULL,(WindowRef)-1);
    ModalDialog(NULL,&itemHit);
    DisposeDialog(dialogPtr);
}

// ***** doDrawStuff

void doDrawStuff(void)
{
    Rect portRect, theRect;
    RGBColor theColor;
    SInt16 a, left, top, right, bottom, random;

    RGBBackColor(&gBlueColor);
    GetWindowPortBounds(gWindowRef,&portRect);
    EraseRect(&portRect);

    for(a=0;a<900;a++)
    {
        theRect = portRect;

        theColor.red = doRandomNumber(0,65535);
        theColor.green = doRandomNumber(0,65535);
        theColor.blue = doRandomNumber(0,65535);
        RGBForeColor(&theColor);

        left = doRandomNumber(0,theRect.right);
        top = doRandomNumber(0,theRect.bottom);
        right = doRandomNumber(left,theRect.right);
        bottom = doRandomNumber(top,theRect.bottom);
        SetRect(&theRect,left,top,right,bottom);

        PenMode(doRandomNumber(addOver,adMin));

        random = doRandomNumber(0,3);

        if(random == 0)
            PaintRect(&theRect);
    }
}

```

```

        else if(random == 1)
            PaintRoundRect(&theRect,doRandomNumber(10,100),doRandomNumber(10,100));
        else if(random == 2)
            PaintOval(&theRect);
        else if(random == 3)
            PaintArc(&theRect,0,doRandomNumber(5,330));

        QDFlushPortBuffer(GetWindowPort(gWindowRef),NULL);
    }
}

// ***** doRandomNumber

UInt16 doRandomNumber(UInt16 minimum, UInt16 maximum)
{
    UInt16 randomNumber;
    SInt32 range, t;

    randomNumber = Random();
    range = maximum - minimum + 1;
    t = (randomNumber * range) / 65536;
    return (t + minimum);
}

// *****

```

## Demonstration Program GWorldPicCursIcn Comments

When this program is run, the user should

- Invoke the demonstrations by choosing items from the Demonstration menu, clicking the mouse when instructed to do so by the text in the window's title bar.
- Click outside and inside the window when the animated cursor demonstrations have been invoked.
- Choose the About... item in the Apple menu to display the About... dialog.
- Note that the Icons item in the Demonstration menu contains an icon.

On Mac OS 8/9, if the first offscreen graphics world demonstration does not work when the monitor color depth is set to Millions, increase the Minimum Heap Size set in the CodeWarrior project.

### defines

Constants are established for the resource IDs of 'acur', 'PICT', 'STR#', icon family, and 'icicn' resources, and a 'DLOG' resource.



kSleeptime and MAX\_UINT32 will be assigned to WaitNextEvent's sleep parameter at various points in the program. kBeachBallTickInterval represents the interval between frame changes for the first of three animated cursors. kCountingHandTickInterval represents the interval between frame changes for the second animated cursor.

### typedefs

The data type anumCurs is identical to the structure of an 'acur' resource.

### Global Variables

In this program, the sleep and cursor region parameters in the WaitNextEvent call will be changed during program execution, hence the global variables gSleepTime and gCursorRegion. gCursorRegion will be assigned a reference to a region which will be passed in the mouseRgn parameter of the WaitNextEvent call. This relates to the cursor shape changing demonstration.

gAnimCursHdl will be assigned a handle to the animCurs structure used during the first animated cursor demonstration. gAnimCursTickInterval and gAnimCursLastTick also relate to the animated cursor demonstration.

### main

Random numbers will be used in the function doPicture. The call to SetQDGlobalsRandomSeed seeds the random number generator with the value returned by the call to GetDateTime.

Note that error handling here and in other areas of the program is somewhat rudimentary: The program simply terminates, sometimes with a call to SysBeep().

### eventLoop

Before the event loop is entered, gSleepTime is set to MAX\_UINT32. Initially, therefore, the sleep parameter in the WaitNextEvent call is set to the maximum possible UInt32 value.

The global variable passed in the mouseRgn parameter of the WaitNextEvent call is assigned NULL so as to defeat the generation of mouse-moved events.

When WaitNextEvent returns 0 with a null event, the function doIdle is called.

### doIdle

doIdle is called from the main event loop when WaitNextEvent returns 0 with a null event. If the active demonstration is one of the first two animated cursor demonstrations, the function doIncrementAnimCursor is called.

### doEvents

In the inDrag case, after the call to DragWindow, and provided the cursor shape changing demonstration is currently under way, the function doChangeCursor is called.

The regions controlling the generation of mouse-moved events are defined in global coordinates, and are based on the window's port rectangle. Accordingly, when the window is moved, the new location of the port rectangle, in global coordinates, must be recalculated so that the various cursor regions may be redefined. The call to `doChangeCursor` redefines these regions for the new window location and copies the reference to one of them, depending on the current location of the mouse cursor, to the global variable `gCursorRegion`. (Note that this call to `doChangeCursor` is also required, for the same reason, when a window is resized or zoomed.)

In the case of a resume event, `SetThemeCursor` is called to ensure that the cursor is set to the arrow shape.

In the case of a mouse-moved event (which occurs when the mouse cursor has moved outside the region whose reference is currently being passed in `WaitNextEvent`'s `mouseRgn` parameter), `doChangeCursor` is called to change the region passed in the `mouseRgn` parameter according to the current location of the mouse.

### **doMenuChoice**

The purpose of the code prior to the switch is to cancel any cursor demonstrations that may be currently under way.

If the second of the first two animated cursor demonstrations is currently under way, `doReleaseAnimCursor` is called to release the memory associated with that animated cursor.

If either of the first two animated cursor demonstrations is currently under way, `SetThemeCursor` is called to set the cursor shape to the arrow shape and `WaitNextEvent`'s sleep parameter is then set to the maximum possible value.

If the third animated cursor demonstration is currently under way, the function `doAnimatedCursorOSX` is called to terminate the Mac OS X wait cursor.

If the cursor shape changing demonstration is currently under way, `gCursorRegionsActive` is set to false, the region containing the current cursor region is disposed of and the associated global variable is set to NULL, thus defeating the generation of mouse-moved events.

Note that, if the user chooses the About... item in the Mac OS 8/9 Apple or Mac OS X Application menu, `doAboutDialog` is called.

### **doOffScreenGWorld1**

`doWithoutOffScreenGWorld` is the first demonstration.

### ***Draw in Window***

As a prelude for what is to come, the function `doDrawStuff` is called to repeatedly paint some shapes in the window.

### ***Draw in Offscreen Graphics Port and Copy to Window***

The call to `GetGWorld` saves the current graphics world—that is, the current graphics port and the current device.

The call to `NewGWorld` creates an offscreen graphics world. The `gworldPortPtr` parameter receives a pointer to the offscreen graphics world's graphics port. 0 in the `pixelDepth` parameter means that the offscreen world's pixel depth will be set to the deepest device intersecting the rectangle passed as the `boundsRect` parameter. This rectangle becomes the offscreen port's port rectangle, the offscreen pixel map's bounding rectangle, and the offscreen device's bounding rectangle. `NULL` in the `cTable` parameter causes the default color table for the pixel depth to be used. The `agDevice` parameter is set to `NULL` because the `noNewDevice` flag is not set. 0 in the `flags` parameter means that no flags are set.

The call to `SetGWorld` sets the graphics port pointed to by `gworldPortPtr` as the current graphics port. (When the first parameter is a `GWorldPtr`, the current device is set to the device attached to the offscreen world and the second parameter is ignored.)

`GetGWorldPixMap` gets a handle to the offscreen pixel map and `LockPixels` is called to prevent the base address of the pixel image from being moved when the pixel image is drawn into or copied from.

The call to `EraseRect` clears the offscreen graphics port before the function `doGWorldDrawing` is called to draw some graphics in the offscreen port.

With the drawing complete, the call to `SetGWorld` sets the (saved) window's graphics port as the current port and the saved device as the current device.

The next two lines establish the source and destination rectangles (required by the forthcoming call to `CopyBits`) as equivalent to the offscreen graphics world and window port rectangles respectively. The calls to `RGBForeColor` and `RGBBackColor` set the foreground and background colors to black and white respectively, which is required to ensure that the `CopyBits` call will produce predictable results in the color sense.

The `CopyBits` call copies the image from the offscreen world to the window. The call to `QDError` checks for any error resulting from the last `QuickDraw` call (in this case, `CopyBits`).

`UnlockPixels` unlocks the offscreen pixel image buffer and `DisposeGWorld` deallocates all of the memory previously allocated for the offscreen graphics world.

### ***doOffScreenGWorld2***

`doWithoutOffScreenGWorld` demonstrates the use of `CopyDeepMask` to copy a source pixel map to a destination pixel map using a pixel map as a mask, and clipping the copying operation to a designated region. Because mask pixel maps cannot come from the screen, an offscreen graphics world is created for the mask.

The first block loads a 'PICT' resource and draws the picture in the window.

The current graphics world is then saved and an offscreen graphics world the same size as the drawn picture is created. The offscreen graphics port is set as the current port, the pixel map is locked, and the offscreen port is erased.

The second call to `GetPicture` loads the 'PICT' resource representing the mask and `DrawPicture` is called to draw the mask in the offscreen port.

`SetGWorld` is then called again to make the window's graphics port the current port. The mask is then also drawn in the window next to the source image so that the user can see a copy of the mask in the offscreen graphics port.

The next two blocks define two regions, one containing an oval and one a rounded rectangle. The references to these regions will be passed in the `maskRgn` parameter of two separate calls to `CopyDeepMask`.

Before the calls to `CopyDeepMask`, the foreground and background colors are set to black and white respectively so that the results of the copying operation, in terms of color, will be predictable.

The for loop causes the source image to be copied to two locations in the window using a different mask region and Boolean source mode for each copy. The first time `CopyDeepMask` is called, the oval-shaped region is passed in the `maskRgn` parameter and the source mode `srcCopy` is passed in the mode parameter. The second time `CopyDeepMask` is called, the round rectangle-shaped region and `srcOr` are passed.

`QDError` checks for any error resulting from the last `QuickDraw` call (in this case, `CopyDeepMask`).

In the clean-up, `UnlockPixels` unlocks the offscreen pixel image buffer, `DisposeGWorld` deallocates all of the memory previously allocated for the offscreen graphics world, and the memory allocated for the picture resources and regions is released. Note that, because the pictures are resources obtained via `GetPicture`, `ReleaseResource`, rather than `KillPicture`, is used.

### **doPicture**

`doPicture` demonstrates the recording and playing back of a picture.

#### ***Define Picture Rectangle and Set Clipping Region***

The window's port rectangle is copied to a local `Rect` variable. This rectangle is then made equal to the left half of the port rectangle, and then inset by 10 pixels all round. This is the picture rectangle

The clipping region is then set to be the equivalent of this rectangle. (Before this call, the clipping region is very large. In fact, it is as large as the coordinate plane. If the clipping region is very large and you scale a picture while drawing it, the clipping region can become invalid when `DrawPicture` scales the clipping region, in which case the picture will not be drawn.)

### ***Set Up OpenCPicParams Structure***

This block assigns values to the fields of an `OpenCPicParams` structure. These specify the previously defined rectangle as the bounding rectangle, and 72 pixels per inch resolution both horizontally and vertically. The version field should always be set to `-2`.

### ***Record Picture***

`OpenCPicture` initiates the recording of the picture definition. The address of the `OpenCPicParams` structure is passed in the `newHeader` parameter.

The picture is then drawn. Lines, rectangles, round rectangles, ovals, wedges, and text are drawn in random colors, and sizes.

### ***Stop Recording, Draw Picture, Restore Saved Clipping Region***

The call to `ClosePicture` terminates picture recording and the call to `DrawPicture` draws the picture by “playing back” the “recording” stored in the specified `Picture` structure.

The call to `SetClip` restores the saved clipping region and `DisposeRgn` frees the memory associated with the saved region.

### ***Display Some Information from the Pictinfo Structure***

The call to `GetPictInfo` returns information about the picture in a picture information structure. Information in some of the fields of this structure is then drawn in the right side of the window.

### ***Release Memory Occupied by Picture Structure***

The call to `KillPicture` releases the memory occupied by the `Picture` structure.

### ***doCursor***

`doCursor`’s chief purpose is to assign `true` to the global variable `gCursorRegionsActive`, which will cause the function `doChangeCursor` to be called from within the main event loop provided the application is not in the background. In addition, it draws some rectangles in the window which visually represent to the user some cursor regions which will later be established by the `doChangeCursor` function.

The last two lines sets the `gCursorRegionsActive` flag to `true` and create an empty region for the last parameter of the `WaitNextEvent` call in the main event loop. A reference to a cursor region will be copied to `gCursorRegion` in the function `doChangeCursor`.

### **doChangeCursor**

`doChangeCursor` is called whenever a mouse-moved event is received and after the window is dragged.

The first four lines create new empty regions to serve as the regions within which the cursor shape will be changed to, respectively, the arrow, I-beam, cross, and plus shapes.

The `SetRectRgn` call sets the arrow cursor region to, initially, the boundaries of the coordinate plane. The next five lines establish a rectangle equivalent to the window's port rectangle and change this rectangle's coordinates from local to global coordinates so that the regions calculated from it will be in the required global coordinates. The call to `InsetRect` insets this rectangle by 40 pixels all round and the call to `RectRgn` establishes this as the I-beam region. The call to `DiffRgn`, in effect, cuts the rectangle represented by the I-beam region from the arrow region, leaving a hollow arrow region.

The next six lines use the same procedure to establish a rectangular hollow region for the cross cursor and an interior rectangular region for the plus cursor. The result of all this is a rectangular plus cursor region in the center of the window, surrounded by (but not overlapped by) a hollow rectangular cross cursor region, this surrounded by (but not overlapped by) a hollow rectangular I-beam cursor region, this surrounded by (but not overlapped by) a hollow rectangular arrow cursor region the outside of which equates to the boundaries of the coordinate plane.

The call to `GetGlobalMouse` gets the point, in global coordinates, representing the mouse's current position.

The next task is to determine the region in which the cursor is currently located. The calls to `PtInRgn` are made for that purpose. Depending on which region is established as the region in which the cursor is currently located, the cursor is set to the appropriate shape and the reference to that region is copied to the global variable passed in `WaitNextEvent`'s `mouseRgn` parameter.

That accomplished, the last four lines deallocate the memory associated with the regions created earlier in the function.

### **doAnimatedCursor1**

`doAnimatedCursor1` responds to the user's selection of the Animated Cursor 1 item in the Demonstration menu.

In this first animated cursor demonstration, the Appearance Manager function `SetAnimatedThemeCursor` will be used in the function `doIncrementAnimCursor` to increment the cursor frame. As preparatory measures, an appropriate frame change tick interval is assigned to `gAnimCursTickInterval`, the sleep parameter in the `WaitNextEvent` call is set to



the same value (causing null events to be generated at that tick interval), and `gAnimCurs1Active` is set to true so that `doIncrementAnimCursor` will be called from the `doIdle` function.

## **doAnimatedCursor2**

`doAnimatedCursor2` responds to the user's selection of the Animated Cursor 2 item in the Demonstration menu.

In this second animated cursor demonstration, functions are utilized to retrieve 'acur' and 'CURS' resources, animate the cursor, and deallocate the memory associated with the animated cursor when the cursor is no longer required. `DoAnimatedCursor2`'s major role is simply to call `doGetAnimCursor` with a "beach-ball" 'acur' resource as a parameter.

After the screen has been cleared, the resource ID of the "beach-ball" 'acur' resource is assigned to the variable used as the first parameter in the later call to `doGetAnimCursor`. The next line assigns a value to the second parameter in the `doGetAnimCursor` call. This value controls the frame rate of the cursor, that is, the number of ticks which must elapse before the next frame (cursor) is displayed. (The best frame rate depends on the type of animated cursor used.)

If the call to `doGetAnimCursor` is successful, the sleep parameter in the `WaitNextEvent` call is set to the same ticks value as that used to control the cursor's frame rate (causing null events to be generated at that tick interval), and the flag `gAnimCurs2Active` is set to true so that `doIncrementAnimCursor` will be called from the `doIdle` function.

If the call to `getAnimCursor` fails, `doAnimCursor` simply plays the system alert sound and returns.

## **doGetAnimCursor**

`doGetAnimCursor` retrieves the data in the specified 'acur' resource and stores it in an `animCurs` structure, retrieves the 'CURS' resources specified in the 'acur' resource and assigns the reference `s` to the resulting Cursor structures to elements in an array in the `animCurs` structure, establishes the frame rate for the cursor, and sets the starting frame number.

`GetResource` is called to read the 'acur' resource into memory and return a handle to the resource. The handle is cast to type `animCursHandle` and assigned to the global variable `gAnimCursHdl` (a handle to a structure of type `animCurs`, which is identical to the structure of an 'acur' resource). If this call is not successful (that is, `GetResource` returns NULL), the function will simply exit, returning false. If the call is successful, `noError` is set to true before a while loop is entered. This loop will cycle once for each of the 'CURS' resources specified in the 'acur' resource, assuming that `noError` is not set to false at some time during this process.



The ID of each cursor is stored in the high word of the specified element of the `frame[]` field of the `animCurs` structure. This is retrieved. The cursor ID is then used in the call to `GetCursor` to read in the resource (if necessary) and assign the handle to the resulting 68-byte `Cursor` structure to the specified element of the `frame[]` field of the `animCurs` structure. If this pass through the loop was successful, the array index is incremented; otherwise, `noError` is set to false, causing the loop and the function to exit.

The first line within the if block assigns the ticks value passed to `doGetAnimCursor` to a global variable that will be utilized in the function `doIncrementAnimCursor`. The next line assigns the number of ticks since system startup to another variable which will also be utilized in the function `doIncrementAnimCursor`. The third line sets the starting frame number.

At this stage, the animated cursor has been initialized and `doIdle` will call `doIncrementAnimCursor` whenever null events are received.

### **doIncrementAnimCursor**

`doIncrementAnimCursor` is called whenever null events are received.

The first line assigns the number of ticks since system startup to `newTick`. The next line checks whether the specified number of ticks have elapsed since the previous call to `doIncrementAnimCursor`. If the specified number of ticks have not elapsed, the function simply returns. Otherwise, the following occurs:

- If the first animated cursor demonstration is under way, the Appearance Manager function `SetThemeAnimatedCursor` is called to increment the theme-compliant cursor frame.
- If the second animated cursor demonstration is under way, `SetCursor` sets the cursor shape to that represented by the handle stored in the specified element of the `frame[]` field of the `animCurs` structure. This line also increments the frame counter field (`whichFrame`) of the `animCurs` structure. If `whichFrame` has been incremented to the last cursor in the series, the frame counter is reset to 0.

The last line retrieves and stores the tick count at exit for use at the first line the next time the function is called.

### **doReleaseAnimCursor**

`doReleaseAnimCursor` deallocates the memory occupied by the `Cursor` structures and the 'acur' resource.

Recall that `doReleaseAnimCursor` is called when the user clicks in the menu bar and that, at the same time, the `gAnimatedCursor1Active` and `gAnimatedCursor2Active` flags are set to false, the cursor is reset to the standard arrow shape, and `WaitNextEvent`'s sleep parameter is reset to the maximum possible value.

## **doAnimatedCursorOSX**

doAnimatedCursorOSX utilizes the function `QDDisplayWaitCursor` to turn the Mac OS X “spinning wheel” cursor on and off. This function is only available on OS X, so the stub library `CarbonFrameworkLib` has been added to the `CodeWarrior` project.

## **dolcon**

doIcon demonstrates the drawing of icons in a window using `PlotIconID`, `PlotIconSuite`, and `PlotCIcon`.

### ***PlotIconID With Transforms***

This block uses the function `PlotIconID` to draw an icon from an icon family with the specified ID fifteen times, once for each of the fifteen available transform types. `PlotIconID` automatically chooses the appropriate icon resource from the icon suite depending on the specified destination rectangle and the bit depth of the current device.

### ***GetIconSuite and PlotIconSuite***

This block uses `GetIconSuite` to get an icon suite comprising only the 'ICN#', 'ic14', and 'ic18' resources from the icon family with the specified resource ID. `PlotIconSuite` is then called three times to draw the appropriate icon within destination rectangles of three different sizes. `PlotIconSuite` automatically chooses the appropriate icon resource from the icon suite depending on the specified destination rectangle and the bit depth of the current device. `PlotIconSuite` also expands the icon to fit the last two destination rectangles.

### ***GetCIcon and PlotCIcon***

This block uses `GetCIcon` to load the specified 'cicn' resource and `PlotCIcon` to draw the color icon within destination rectangles of three different sizes. `PlotCIcon` expands the 32-by-32-pixel icon to fit the last two destination rectangles.

## **doAboutDialog**

doAboutDialog is called when the user chooses the About... item in the Apple menu.

GetNewDialog creates a modal dialog. The dialog's item list contains a picture item, which fills the entire dialog window.

The call to `ModalDialog` means that the dialog will remain displayed until the user clicks somewhere within the dialog, at which time `DisposeDialog` is called to dismiss the dialog and free the associated memory. A dialog rather than an alert is used to obviate the need for a button for dismissing the dialog.



# More on Controls

## CHAPTER

# 14

## IN THIS CHAPTER

- Introduction 662
- Control Descriptions 663
- Small Versions of Controls 709
- Idle Processing 711
- Defining Your Own Key Filter Function 711
- Defining Your Own Edit Text Validation Function 713
- Defining Your Own User Pane Functions 714
- Main Constants, Data Types and Functions 718
- Demonstration Program Controls3 Listing 728
- Demonstration Program Controls3 Comments 778

## Introduction

Chapter 7 introduced the subject of controls and addressed the basic controls (push buttons, check boxes, radio buttons, scroll bars, and pop-up menu buttons), primary group boxes (text title variant) and user panes. This chapter revisits group boxes and user panes and addresses the many remaining controls.

The controls addressed in this chapter are as follows:

Bevel button	Image well	Tab
Group boxes	Clock	Progress and relevance bar
Picture	Icon	Window header
Separator line	Pop-up arrow	Radio group
Scrolling text box	Disclosure button	Edit Unicode text
Edit text	Little arrows	Placard
Slider	Disclosure triangle	Chasing arrows
Round button	Static text	User pane

The data browser control is not addressed in this book. The one remaining control (the list box) is addressed in Chapter 22.

The Progress bar will be described in this chapter and the indeterminate variant demonstrated in the associated demonstration program. However, because the use of the determinate variant is ordinarily associated with the matter of scanning for a Command-period event, the demonstration of that particular variant has been held over to the demonstration program associated with Chapter 25.

## Preamble—Review of Control Basics

Recall from Chapter 7 that

- Control definition functions (**CDEFs**) determine the appearance and behavior of controls.
- Two new features introduced with Mac OS 8 were **embedding** and **latency**. Embedding hierarchies have implications for drawing order and hit testing.
- Another feature introduced with Mac OS 8 was read and write access to the various attributes of a control. Each piece of information that a particular CDEF allows access to is referenced by a control data tag. **Control data tag constants** are passed in the `inTagName` parameter of the getter and setter functions `SetControlData` and `GetControlData`.



- `FindControl` is used to determine whether a mouse-down event occurred in a control and, if so, which control. `FindControl` returns a **control part code** identifying the part of the control in which the mouse-down occurred. `kControlNoPart` (0) is returned if the mouse-down occurred where no enabled control exists. `TrackControl` or `HandleControlClick` are used to handle user interaction with a control as long as the user holds the mouse button down. These two functions return `kControlNoPart` if the cursor is outside the control or control part when the mouse button is released or the relevant control part code if the user releases the mouse button while the cursor is still inside the control or control part.
- The font for any control can be set independently of the system or window font.
- The pop-up menu button differs from the other basic controls in that the control's initial, minimum, and maximum values do not actually represent initial, minimum, and maximum values as such. For example, the minimum value field of the 'CNTL' resource for a pop-up button is used to specify the resource ID of the 'MENU' resource utilized by the control.

The use of the initial, minimum, and maximum fields for purposes other than control values as such also applies to most of the controls addressed in this chapter.

## More on Embedding

As stated in Chapter 8, if the `kDialogFlagsUseControlHierarchy` feature bit is set in a dialog's 'dlgx' resource, the Dialog Manager creates a root control in the dialog and establishes an embedding hierarchy.

The Dialog Manager uses `AutoEmbedControl` to position dialog items in an embedding hierarchy based on both visual containment and the order of the items in the item list. As items are added to a dialog during creation, controls that already exist in the window will be containers for new controls if they both visually contain the control and are themselves embedder controls. For this reason, you should place the largest embedder controls at the beginning of the item list. As an example, the Dialog Manager will automatically embed radio buttons in a group box if the radio buttons visually “fit” inside the group box and the group box precedes the radio buttons in the item list.

## Control Descriptions

### Bevel Buttons

A bevel button is a rectangular control with a beveled edge that can include text, an icon, a picture, or a combination of text and an icon or picture. Bevel buttons can be made to behave in a number of different ways: They can behave like push buttons; in sets, they can behave like radio buttons or checkboxes; if a menu is attached, they behave like pop-up menu buttons. Typical bevel buttons are shown in Fig 1.

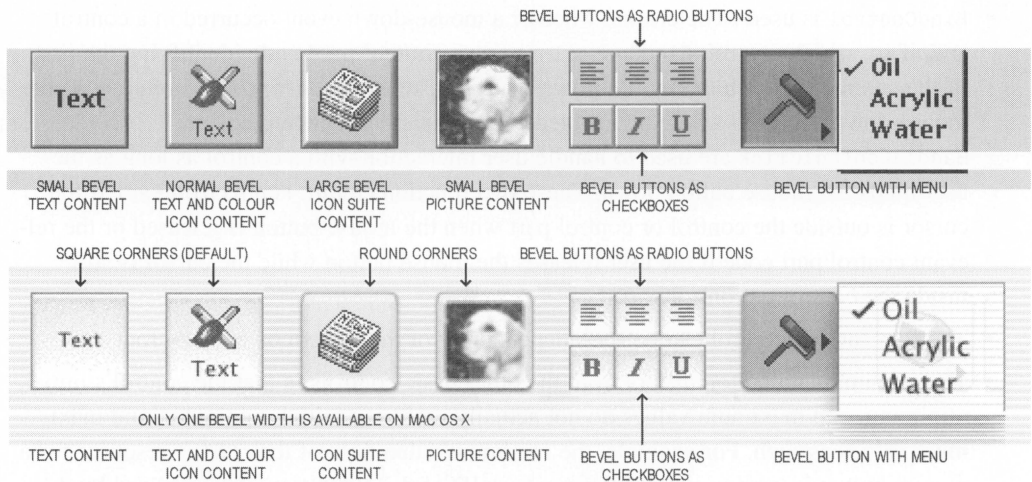


FIG 1 - TYPICAL BEVEL BUTTONS

Note that, on Mac OS X, bevel button have square corners by default but can be made rounded using the function `SetControlData` with the `kControlBevelButtonKindTag` tag (see “Other Control Data Tag Constants” later in this chapter).

## Variants and Control Definition IDs

The bevel button CDEF resource ID is 2. The six available variants and their control definition IDs are as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
With small (2 pixel wide) bevel. (Pop-up menu, if any, below.)	0	32 <code>kControlBevelButtonSmallBevelProc</code>
With medium (3 pixel wide) bevel. (Pop-up menu, if any, below.)	1	33 <code>kControlBevelButtonNormalBevelProc</code>
With large (4 pixel wide) bevel. (Pop-up menu, if any, below.)	2	34 <code>kControlBevelButtonLargeBevelProc</code>
With small (2 pixel wide) bevel. Pop-up menu on right.	4	36 <code>KControlBevelButtonSmallBevelProc + kControlBevelButtonMenuOnRight</code>



<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
With medium (3 pixel wide) bevel. Pop-up menu, if any, on right.	5	37 KControlBevelButtonNormalBevelProc + kControlBevelButtonMenuOnRight
With large (4 pixel wide) bevel. Pop-up menu, if any, on right.	6	38 KControlBevelButtonLargeBevelProc + kControlBevelButtonMenuOnRight

Note that, while three bevel sizes are available on Mac OS 8/9, bevel button will always be displayed with one bevel size on Mac OS X regardless of which of the first three variants is used.

For bevel buttons containing text, if the constant `kControlUsesOwningWindowsFontVariant` is added to the variation code, the text will appear in the window's font.

## Control Values

The following lists the initial, minimum, and maximum value settings for bevel buttons:

<i>Control Value</i>	<i>Content</i>
Initial	If you wish to attach a menu, the menu ID. If no menu, 0.
Minimum	High byte specifies behavior (see “Bevel Button Behavior Constants,” and “Bevel Button Menu Constants”). Low byte specifies content type (see “Bevel Button and Image Well Content Type Constants”).
Maximum	Resource ID of bevel button's content if resource-based.

Note that bevel buttons have two values: the value of the bevel button and, if a menu has been attached, the value of the menu.

## Bevel Button Behavior Constants

The following **bevel button behavior constants** apply to the high byte of a bevel button's minimum value:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kControlBehaviorPushbutton</code>	<code>0</code>	Button pops up after being clicked. This constant is used when push button behavior is required.
<code>kControlBehaviorToggles</code>	<code>0x0100</code>	Button toggles state automatically when clicked. This constant is used when checkbox or radio button behavior is required.
<code>kControlBehaviorSticky</code>	<code>0x0200</code>	When clicked, button stays down until application sets control's value to 0. This behavior is useful in tool palettes.
<code>kControlBehaviorOffsetContents</code>	<code>0x8000</code>	Button contents are offset (one pixel down and to the right) when button is clicked. (Some users consider that this behavior gives a bevel button a more realistic "feel.")

### Bevel Button Behavior Constants (Menus)

The following bevel button behavior constants (menus) apply to the high byte of a bevel button's minimum value:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kControlBehaviorSingleValueMenu</code>	<code>0</code>	Menu contains commands, not choices, and should not be marked with a checkmark. Overrides the <code>kControlBehaviorMultiValueMenu</code> bit.
<code>kControlBehaviorMultiValueMenu</code>	<code>0x4000</code>	Menus are multi-valued. The user can toggle entries in the button's menu and have multiple items checked. The button does not maintain the menu value as it normally would. When this bit is set, the menu value accessed using <code>GetControlData</code> with the <code>kControlBevelButtonMenuValueTag</code> will return the value of the last menu item chosen.

## Button and Image Well Content Type Constants

The following **button and image well content type constants** apply to the low byte of a bevel button's minimum value:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kControlContentTextOnly</code>	0	Content type is text only.
<code>kControlContentIconSuiteRes</code>	1	Content type is an icon suite resource ID.
<code>kControlContentCIconRes</code>	2	Content type is a color icon resource ID.
<code>kControlContentPictRes</code>	3	Content type is a picture resource ID.
<code>kControlContentIconSuiteHandle</code>	129	Content type is an icon suite handle.
<code>kControlContentCIconHandle</code>	130	Content type is a color icon handle.
<code>kControlContentPictHandle</code>	131	Content type is a picture handle.
<code>kControlContentIconRef</code>	132	Content type is an icon reference.

You can also use these constants in the `contentType` field of the **button content info structure**. You can then pass a pointer to this structure in the `inBuffer` parameter of `GetControlData` and `SetControlData` to get and set the resource ID (for resource-based content), handle (for handle-based content), or reference (for reference-based content) of a color icon, icon suite, picture, or icon reference in a bevel button.

### NOTE

Note that resource-based content is owned by the control, while handle-based content is owned by you. The control definition function will not dispose of handle-based content. If you replace handle-based content with resource-based content on the fly, you must dispose of the handle properly to avoid a memory leak.

## Control Data Tag Constant—Content Type

The control data tag constant relevant to content type in bevel buttons is as follows:

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
<code>kControlBevelButtonContentTag</code>	Gets or sets a bevel button's content type for drawing. (See “Bevel Button and Image Well Content Type Constants.” See also “The Bevel Button and Image Well Structure” section later in this chapter.)  <b>Data type returned or set:</b> <code>ControlButtonContentInfo</code> structure

## Bevel Button Alignment and Placement Constants and Associated Control Data Tag Constants

By calling `SetControlData` with certain control data tag constants, and with certain constants passed in the `inData` parameter, you can specify the alignment of icons, pictures, and text in a bevel button, and you can specify the placement of text in relation to an icon or picture. By calling `GetControlData` with these constants you can also ascertain alignment and placement.

### Bevel Button Graphic Alignment Constants

The following constants are used to specify the alignment of icon suites, color icons, and pictures:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kControlBevelButtonAlignSysDirection</code>	-1	Graphic is aligned according to the system default script direction (only left or right).
<code>kControlBevelButtonAlignCenter</code>	0	Graphic is aligned center.
<code>kControlBevelButtonAlignLeft</code>	1	Graphic is aligned left.
<code>kControlBevelButtonAlignRight</code>	2	Graphic is aligned right.
<code>kControlBevelButtonAlignTop</code>	3	Graphic is aligned top.
<code>kControlBevelButtonAlignBottom</code>	4	Graphic is aligned bottom.
<code>kControlBevelButtonAlignTopLeft</code>	5	Graphic is aligned top left.
<code>kControlBevelButtonAlignBottomLeft</code>	6	Graphic is aligned bottom left.
<code>kControlBevelButtonAlignTopRight</code>	7	Graphic is aligned top right.
<code>kControlBevelButtonAlignBottomRight</code>	8	Graphic is aligned bottom right.

### Bevel Button Text Alignment Constants

The following constants are used to specify the alignment of text:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kControlBevelButtonAlignTextSysDirection</code> the current script direction (left or right).	0	Text is aligned according to
<code>kControlBevelButtonAlignTextCenter</code>	1	Text is aligned center.
<code>kControlBevelButtonAlignTextFlushRight</code>	-1	Text is aligned flush right.
<code>kControlBevelButtonAlignTextFlushLeft</code>	-2	Text is aligned flush left.

## Bevel Button Text Placement Constants

The following constants are used to specify the placement of text in relation to an icon suite, color icon, or picture:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kControlBevelButtonPlaceSysDirection</code>	-1	Text is placed according to the system default script direction.
<code>kControlBevelButtonPlaceNormally</code>	0	Text is centered.
<code>kControlBevelButtonPlaceToRightOfGraphic</code>	1	Text is placed to the right of the graphic.
<code>kControlBevelButtonPlaceToLeftOfGraphic</code>	2	Text is placed to the left of the graphic.
<code>kControlBevelButtonPlaceBelowGraphic</code>	3	Text is placed below the graphic.
<code>kControlBevelButtonPlaceAboveGraphic</code>	4	Text is placed above the graphic.

## Control Data Tag Constants—Alignment and Placement

The control data tag constants relevant to the alignment and placement of graphics and text in bevel buttons are as follows:

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
<code>kControlBevelButtonTextAlignTag</code>	Gets or sets the alignment of text. (See “Bevel Button Text Alignment Constants.”) <b>Data type returned or set:</b> <code>ControlButtonTextAlignment</code>
<code>kControlBevelButtonGraphicAlignTag</code>	Gets or sets the alignment of graphics in relation to any text the button may contain. (See “Bevel Button Graphic Alignment Constants.”) <b>Data type returned or set:</b> <code>ControlButtonGraphicAlignment</code>
<code>kControlBevelButtonTextPlaceTag</code>	Gets or sets the placement of text. (See “Bevel Button Text Placement Constants.”) <b>Data type returned or set:</b> <code>ControlButtonTextPlacement</code>
<code>kControlBevelButtonTextOffsetTag</code>	Gets or sets the number of pixels that text is offset from the button’s left or right edge. This is used with left, right, or system justification, but it is ignored when the text is center aligned. <b>Data type returned or set:</b> <code>SInt16</code>

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
<code>kControlBevelButtonGraphicOffsetTag</code>	Gets or sets the horizontal and vertical amounts that a graphic element is offset from the button's edges. Ignored when the graphic is specified to be centered on the button.  <b>Data type returned or set:</b> <code>Point</code>

## The Button Content Info Structure

As previously stated, you can use button and image well content type constants in the `contentType` field of the **button content info structure** and you can then pass a pointer to this structure in the `inBuffer` parameter of `GetControlData` and `SetControlData`. The button content info structure is as follows:

```
struct ControlButtonContentInfo
{
    ControlContentType contentType;
    union {
        SInt16      resID;
        CIconHandle cIconHandle;
        Handle      iconSuite;
        IconRef      iconRef;
        PicHandle    picture;
        Handle      ICONHandle;
    } u;
};

typedef struct ControlButtonContentInfo ControlButtonContentInfo;
typedef ControlButtonContentInfo *ControlButtonContentInfoPtr;
typedef ControlButtonContentInfo ControlImageContentInfo;
typedef ControlButtonContentInfo *ControlImageContentInfoPtr;
```

## Field Descriptions

**contentType** Specifies the content type (see “Bevel Button and Image Well Content Type Constants”) and determines which of the following fields are used.

**resID** If the content type specified in the `contentType` field is `kControlContentIconSuiteRes`, `kControlContentCIconRes`, or `kControlContentPictRes`, this field should contain the resource ID of a picture, color icon, or icon suite resource.

**cIconHandle** If the content type specified in the `contentType` field is `kControlContentCIconHandle`, this field should contain a handle to a color icon.

**iconSuite** If the content type specified in the `contentType` field is `kControlContentIconSuiteHandle`, this field should contain a handle to an icon suite.

**iconRef** If the content type specified in the `contentType` field is `kControlContentIconRef`, this field should contain an icon reference.



`picture` If the content type specified in the `contentType` field is `kControlContentPictHandle`, this field should contain a handle to a picture.

## Other Control Data Tag Constants

The remaining control data tag constants relevant to bevel buttons are as follows:

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
<code>kControlBevelButtonCenterPopUpGlyphTag</code>	Gets or sets the position of the pop-up arrow when a pop-up menu is attached.  <b>Data type returned or set:</b> Boolean. If true, glyph is vertically centered on the right; if false, glyph is on the bottom right.
<code>kControlBevelButtonTransformTag</code>	Gets or sets a transform that is added to the standard transform. See the Icons section in Chapter 13.)  <b>Data type returned or set:</b> <code>IconTransformType</code>
<code>kControlBevelButtonMenuValueTag</code>	Gets the menu value. (See “Bevel Button Menu Constants.”)  <b>Data type returned:</b> <code>SInt16</code>
<code>kControlBevelButtonMenuRefTag</code>	Gets the menu reference.  <b>Data type returned:</b> <code>MenuRef</code>
<code>kControlBevelButtonLastMenuTag</code>	Gets the menu ID of the last menu selected in the submenu or main menu.  <b>Data type returned:</b> Boolean
<code>kControlBevelButtonMenuDelayTag</code>	Gets or sets the delay (in number of ticks) before the menu is displayed.  <b>Data type returned or set:</b> <code>SInt32</code>
<code>kControlBevelButtonScaleIconTag</code>	Gets or sets whether, when the proper icon size is unavailable, the icon should be scaled. For use only with icon suites or the <code>IconRef</code> data type.  <b>Data type returned or set:</b> Boolean. If true, indicates that if an icon of the ideal size is not available a larger or smaller icon should be scaled. If false, no scaling should occur; instead, a smaller icon should be drawn or a larger icon clipped.



<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
<code>kControlBevelButtonContentTag</code>	Sets bevel button content. <b>Data type reset:</b> <code>ButtonContentInfo</code>
<code>kControlBevelButtonOwnedMenuRefTag</code>	Sets the menu reference. (The control will dispose.) <b>Data type set:</b> <code>MenuRef</code>
<code>kControlBevelButtonKindTag</code>	Sets the button kind. <b>Data type returned or set:</b> <code>ThemeButtonKind</code> ( <code>kThemeSmallBevelButton</code> , <code>kThemeMediumBevelButton</code> , <code>kThemeLargeBevelButton</code> , <code>kThemeRoundedBevelButton</code> ).

With regard to the `kControlBevelButtonMenuDelayTag` constant, setting a delay before the menu is displayed in a bevel button with sticky behavior is useful for providing option sets in tool palettes. You can set up the bevel button so that

- If the user clicks it once, it simply turns on the function represented by the button.
- If the user presses it for longer than the user-set double-click time, it displays a pop-up menu which offers further options for that function.

## Helper Functions

The following helper functions may be used in lieu of `SetControlData` and `GetControlData` with the relevant control data tags:

```

GetBevelButtonMenuValue
SetBevelButtonMenuValue
GetBevelButtonMenuHandle
GetBevelButtonContentInfo
SetBevelButtonContentInfo
SetBevelButtonTransform
SetBevelButtonGraphicAlignment
SetBevelButtonTextAlignment
SetBevelButtonTextPlacement

```

## Control Part Codes

The following control part codes are relevant to bevel buttons:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
kControlNoPart	0	For bevel buttons with a menu attached, this part code indicates that either the mouse was released outside the bevel button and menu or that the button was disabled.
kControlMenuPart	2	For bevel buttons with a menu attached, this part code indicates that the event occurred in a menu item of the bevel button.
kControlButtonPart	10	For bevel buttons with a menu attached, this part code indicates that the event occurred in the button but not in the attached menu.

## Bevel Button States

Bevel buttons can exist in five active states and two disabled states. The active states are off, pressed (was off) on, pressed (was on), and mixed. The mixed state is used, where appropriate, when the bevel button is behaving as a checkbox or radio button. Disabled bevel buttons can be shown as off or on.

## Programmatic Creation

Bevel button controls may be created programmatically using the function

CreateBevelButtonControl:

```
OSStatus CreateBevelButtonControl(WindowRef window, const Rect *boundsRect,
                                   CFStringRef title, ControlBevelThickness thickness,
                                   ControlBevelButtonBehavior behavior,
                                   ControlButtonContentInfoPtr info, SInt16 menuID,
                                   ControlBevelButtonMenuBehavior menuBehavior,
                                   ControlBevelButtonMenuPlacement menuPlacement,
                                   ControlRef *outControl);
```

Relevant constants are

<i>Parameter</i>	<i>Constants</i>
thickness	kControlBevelButtonSmallBevel kControlBevelButtonNormalBevel kControlBevelButtonLargeBevel
behavior	See “Bevel Button Behavior Constants.”
info.contentType	See “Button and Image Well Content Type Constants.”
menuBehavior	See “Bevel Button Behavior Constants (Menus).”
menuPlacement	kControlBevelButtonMenuOnBottom kControlBevelButtonMenuOnRight

## Image Wells

Image wells can be used to display icons or pictures. They are controlled in much the same way as bevel buttons, but with fewer options and states. They should not be used in place of push buttons or bevel buttons. Typical image wells are shown in Fig 2.

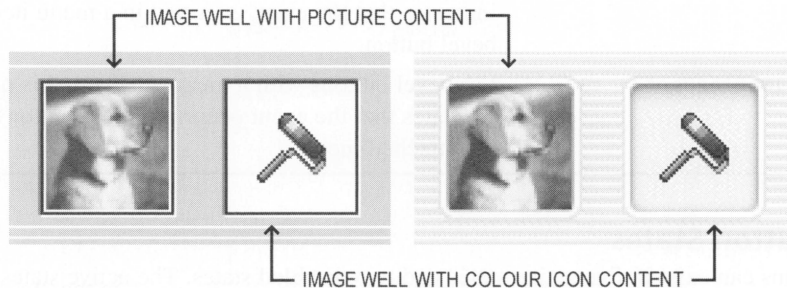


FIG 2 - TYPICAL IMAGE WELLS

### Variants and Control Definition IDs

The image well CDEF resource ID is 11. The one available variant and its control definition IDs is as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
Image well	0	176 kControlImageWellProc

### Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Resource ID of image well's content ('cicn', 'PICT' or icon suite).
Minimum	Content type. (See “Bevel Button and Image Well Content Type Constants.”) After the image well is created, reset to 0.
Maximum	Ignored. Reset to 2 after creation.

### Bevel Button and Image Well Content Type Constants and The Button Content Info Structure

The button and image well content type constants (see “Bevel Buttons”) apply to an image well's minimum value.

You can also use these constants in the `contentType` field of the button content info structure (see “Bevel Buttons”). You can then pass a pointer to this structure in the `inBuffer` parameter of `GetControlData` and `SetControlData` to get and set the resource ID (for resource-based content) or handle (for handle-based content) of a color icon, icon suite, or picture in an image well.

## Control Data Tag Constants

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
<code>kControlImageWellContentTag</code>	Gets or sets the content. (See “The Button Content Info Structure.”) <b>Data type returned or set:</b> <code>ControlButtonContentInfo</code> structure
<code>kControlImageWellTransformTag</code>	Gets or sets a transform that is added to the standard transform. (See the “Icons” section in Chapter 13.) <b>Data type returned or set:</b> <code>IconTransformType</code>
<code>kControlImageWellIsDragDestinationTag</code>	<b>Data type returned or set:</b> Boolean

## Helper Functions

The following helper functions may be used in lieu of `SetControlData` and `GetControlData` with the relevant control data tag constants:

```
GetImageWellContentInfo
SetImageWellContentInfo
SetImageWellTransform
```

## Control Part Codes

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kControlImageWellPart</code>	26	Event occurred in an image well

## Programmatic Creation

Image well controls may be created programmatically using the function

`CreateImageWellControl`:

```
OSStatus CreateImageWellControl(WindowRef window, const Rect *boundsRect,
                                const ControlButtonContentInfo *info,
                                ControlRef *outControl);
```

Relevant constants are

<i>Parameter</i>	<i>Constants</i>
<code>info.contentType</code>	See “Button and Image Well Content Type Constants.”

## Tab—Embedding Control

The tab control is an embedding control which provides a means of presenting information on multiple “pages.” The user selects the desired “page” by clicking the appropriate tab.

A typical tab control is shown in Fig 3.

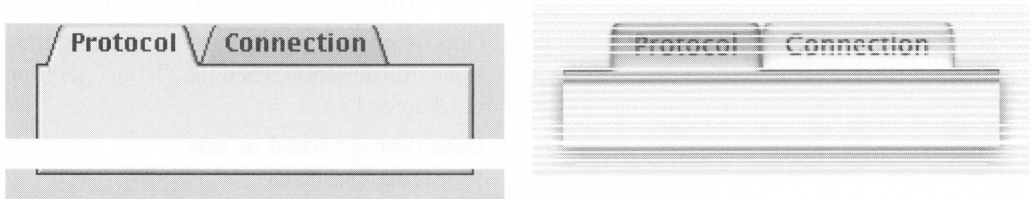


FIG 3 - TAB CONTROL

The content area of a tab is known as a **pane**. Controls that are embedded within an individual pane should only affect the settings displayed in that pane. Controls whose effect is intended to be global (that is, their settings are intended to affect all the panes in a set of tabs) should be located outside the tab control.

The tab information (‘tab#’) resource may be used to provide the tab names and icon suite IDs.

## Variants and Control Definition IDs

The tab control CDEF resource ID is 8. The eight available variants and their control definition ID are follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>	
Large tab control, tabs at top.	0	128	<code>kControl1TabLargeNorthProc</code>
Small tab control, tabs at top.	1	129	<code>kControl1TabSmallNorthProc</code>
Large tab control, tabs at bottom.	2	130	<code>kControl1TabLargeSouthProc</code>

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>	
Small tab control, tabs at bottom.	3	131	kControlTabSmallSouthProc
Large tab control, tabs at right.	4	132	kControlTabLargeEastProc
Small tab control, tabs at right.	5	133	kControlTabSmallEastProc
Large tab control, tabs at left.	6	134	kControlTabLargeWestProc
Small tab control, tabs at left.	7	135	kControlTabSmallWestProc

## Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Resource ID of the 'tab#' resource you are using to hold tab information. Reset to the minimum setting after creation. A value of 0 indicates not to read a 'tab#' resource. (See “The Tab Information Structure.”)
Minimum	Ignored. Reset to 1 after creation.
Maximum	Ignored. Reset to the number of individual tabs in the tab control after creation.

## Control Data Tag Constants

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
kControlTabContentRectTag	Gets the content rectangle. <b>Data type returned:</b> Rect
kControlTabEnabledFlagTag	Enables or disables a single tab. <b>Data type returned or set:</b> Boolean; if true, enabled; if false, disabled.
kControlTabFontStyleTag	Gets or sets the font and font style. <b>Data type returned or set:</b> ControlFontStyleRec
kControlTabInfoTag	Gets or sets information for a tab in a tab control. (See “The Tab Information Structure.”) <b>Data type returned or set:</b> ControlTabInfoRec

## Helper Functions

The following helper functions may be used in lieu of `SetControlData` and `GetControlData` with the relevant control data tags:

```
GetTabContentRect
SetTabEnabled
```

## The Tab Information Structure

If you are not creating a tab control with a 'tab#' resource, you can call `SetControlMaximum` to set the number of tabs in a tab control and then call `SetControlData` with the `kControlTabInfoTag` to set the information for an individual tab in a tab control. The tab information structure passed in the `SetControlData` call should be one of the following:

```
struct ControlTabInfoRec
{
    SInt16 version;           // Set to kControlTabInfoVersionZero.
    SInt16 iconSuiteID;       // Set to 0 for no icon.
    Str255 name;              // Title for tab label.
};
typedef struct ControlTabInfoRec ControlTabInfoRec;

struct ControlTabInfoRecV1
{
    SInt16 version;           // Set to kControlTabInfoVersionOne.
    SInt16 iconSuiteID;       // Set to 0 for no icon.
    CFStringRef name;         // Title for tab label. (Should always be released)
};
typedef struct ControlTabInfoRecV1 ControlTabInfoRecV1;
```

## The Tab Information Resource

You can use a tab information resource to specify the icon suite ID and name of each tab in a tab control. A tab information resource is a resource of type 'tab#'. All tab information resources must have resource ID numbers greater than 127. The Control Manager uses the information you specify to provide additional information to the corresponding tab control. Fig 4 shows the structure of a compiled 'tab#' resource.

The following describes the fields of a compiled 'tab#' resource and one of its tab information entries:

<i>Field</i>	<i>Description</i>
VERSION NUMBER	Version of the resource
NUMBER OF ENTRIES	The number of tab information entries in the resource
ICON SUITE ID	Icon suite resource ID
TAB NAME	The tab name



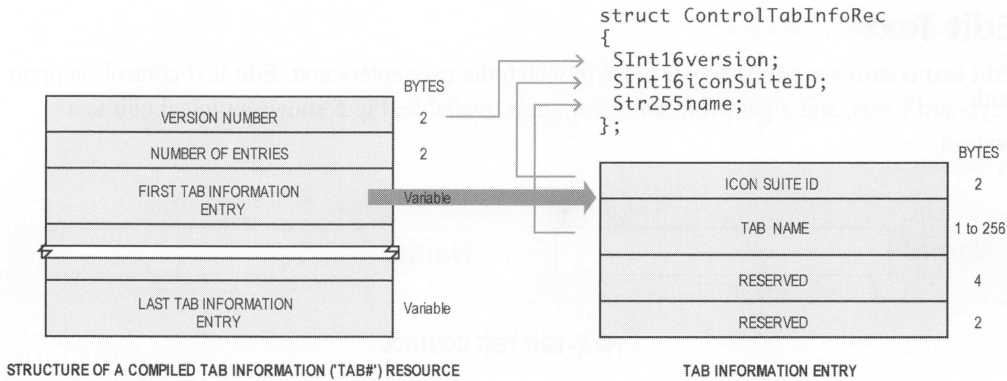


FIG 4 - STRUCTURE OF A COMPILED TAB INFORMATION ('tab#') RESOURCE

## Programmatic Creation

Tab controls may be created programmatically using the function `CreateTabsControl`:

```
OSStatus CreateTabsControl(WindowRef window, const Rect *boundsRect, ControlTabSize size,
    ControlTabDirection direction, UInt16 numTabs,
    const ControlTabEntry *tabArray,
    ControlRef *outControl);
```

Relevant constants are

Parameter	Constants
size	kControlTabSizeLarge
	kControlTabSizeSmall
direction	kControlTabDirectionNorth
	kControlTabDirectionSouth
	kControlTabDirectionEast
	kControlTabDirectionWest

The `tabArray` parameter of takes a pointer to an array of **tab entry structures**:

```
struct ControlTabEntry
{
    ControlButtonContentInfo *icon;
    CFStringRef name;
    Boolean enabled;
};
typedef struct ControlTabEntry ControlTabEntry;
```

## Edit Text

Edit text controls are rectangular areas in which the user enters text. Edit text controls support keyboard focus, and a password entry variant is available. Fig 5 shows a typical edit text control.

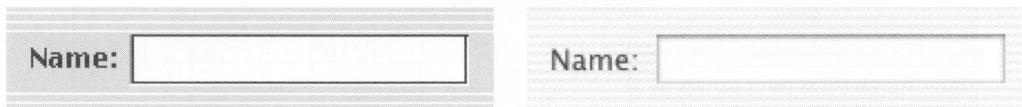


FIG 5 - EDIT TEXT CONTROL

Edit text controls can have a key filter function attached to filter key strokes or modify them on return.

## Variants and Control Definition IDs

The edit text control CDEF resource ID is 17. The three available variants and their control definition IDs are as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>	
Edit text control.	0	272	kControlEditTextProc
Edit text control for passwords. This control is supported by the Script Manager. Password text can be accessed via the kEditTextPasswordTag constant. (See “Control Data Tag Constants.”)	2	274	kControlEditTextPasswordProc
Edit text control for inline input. This control supports 2-byte script systems.	4	276	kControlEditTextInlineInputProc

## Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Reserved. Set to 0.
Minimum	Reserved. Set to 0.
Maximum	Reserved. Set to 0.

## Main Control Data Tag Constants

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
kControlEditTextTextTag	Gets or sets text. <b>Data type returned or set:</b> character buffer
kControlEditTextTEHandleTag	Gets a handle to the text edit structure. <b>Data type returned or set:</b> TEHandle
kControlEditTextSelectionTag	Gets or sets the selection. <b>Data type returned or set:</b> ControlEditTextSelectionRec structure. (See “The Edit Text Selection Structure.”)
kControlEditTextPasswordTag	Gets clear password text, that is, the text of the actual password typed, not the bullet text. <b>Data type returned or set:</b> character buffer
kControlKeyFilterTag	Gets or sets a key filter function. <b>Data type returned or set:</b> ControlKeyFilterUPP
kControlEditTextStyleTag	Gets or sets the font style. <b>Data type returned or set:</b> ControlFontStyleRec
KControlEditTextLockedTag	Gets or sets whether the text is currently editable. <b>Data type returned or set:</b> Boolean. If true, text is locked. If false, text is editable
kControlEditTextValidationProcTag	Gets or sets a universal procedure pointer to a callback function which can be used to validate editable text after an operation that changes the text, such as a cut or paste. <b>Data type returned or set:</b> ControlEditTextValidationUPP
kControlEditTextCFStringTag	Gets or sets text. (Mac OS X only.) <b>Data type returned or set:</b> CFStringRef

## Control Part Codes

<i>Constant</i>	<i>Value</i>	<i>Description</i>
kControlEditTextPart	5	Event occurred in an Edit text control.

## The Edit Text Selection Structure

You can pass a pointer to the edit text selection structure to `GetControlData` and `SetControlData` to access and set the current selection range in an edit text control. An edit text selection structure is of type `ControlEditTextSelectionRec`:

```
struct ControlEditTextSelectionRec
{
    SInt16 selStart;
    SInt16 selEnd;
};
typedef struct ControlEditTextSelectionRec ControlEditTextSelectionRec;
typedef ControlEditTextSelectionRec *ControlEditTextSelectionPtr;
```

### Field Descriptions

`selStart` Beginning of the edit text selection.

`selEnd` End of the edit text selection.

### Programmatic Creation

Edit text controls may be created programmatically using the function `CreateEditTextControl`:

```
OSStatus CreateEditTextControl(WindowRef window, const Rect *boundsRect, CFStringRef text,
                               Boolean isPassword, Boolean useInlineInput,
                               const ControlFontStyleRec *style, ControlRef *outControl);
```

## Sliders

A slider control comprises a **slider bar** and an **indicator**. The user can drag the indicator to set a new value within the range represented by the slider bar.

Sliders can be oriented horizontally or vertically, and the indicator can point in any direction. The indicator can also be nondirectional if required. Typical sliders are shown in Fig 6.

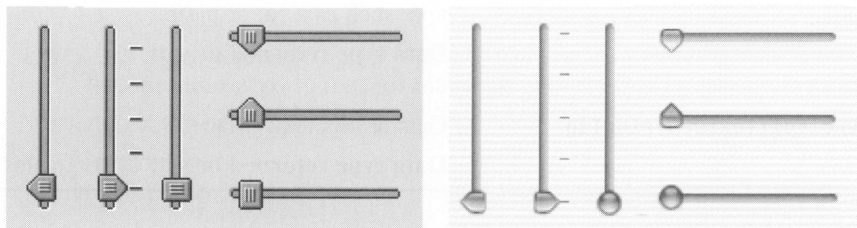


FIG 6 - SLIDERS

A slider can, optionally, display tick marks, and you can specify the number of tick marks required. If you specify tick marks, you should ensure that they are labeled.

A live feedback variant is available. This variant continually updates the value of the control as the indicator is dragged, as opposed to the standard behavior of updating the value only when the mouse button is released.

## Variants and Control Definition IDs

The slider CDEF resource ID is 3. The ten available variants and their control definition IDs are as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>	
Slider. If the slider is horizontal, the indicator points down, and if the slider is vertical, the indicator points right.	0	48	kControlSliderProc
Slider with live feedback. The value of the control is updated automatically by the Control Manager before your action function is called. If no application-defined action function is supplied, the slider draws ghosted image of the indicator as the user moves it.	1	49	kControlSliderProc + kControlSliderLiveFeedback
Slider with tick marks. The control rectangle must be large enough to include the tick marks.	2	50	kControlSliderProc + kControlSliderHasTickMarks
Slider with live feedback and tick marks.	3	51	kControlSliderProc + kControlSliderLiveFeedback + kControlSliderHasTickMarks
Slider with indicator reversed. If the slider is horizontal, the indicator points up, and if the slider is vertical, the indicator points left.	4	52	kControlSliderProc + kControlSliderReverseDirection

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>	
Slider with live feedback and indicator reversed.	5	53	kControlSliderProc+ kControlSliderLiveFeedback + kControlSliderReverseDirection
Slider with tick marks and indicator reversed.	6	54	kControlSliderProc + kControlSliderHasTickMarks + kControlSliderReverseDirection
Slider with live feedback, tick marks and indicator reversed.	7	55	kControlSliderProc + kControlSliderLiveFeedback + kControlSliderHasTickMarks + kControlSliderReverseDirection
Slider with a rectangular, non-directional indicator.	8	56	kControlSliderProc + kControlSliderNonDirectional
Slider with live feedback and a rectangular, non-directional indicator.	9	57	kControlSliderProc + kControlSliderLiveFeedback + kControlSliderNonDirectional

## Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Appropriate value between –32768 and 32768. For the tick mark variant, the number of ticks required. Reset to the minimum setting after creation.
Minimum	–32768 to 32768.
Maximum	–32768 to 32768. When the maximum setting is equal to the minimum setting, the slider is inactive.

## Control Part Codes

<i>Constant</i>	<i>Value</i>	<i>Description</i>
kControlIndicatorPart	129	Event occurred in the indicator

## Programmatic Creation

Slider controls may be created programmatically using the function `CreateSliderControl`:

```
OSStatus CreateSliderControl(WindowRef window, const Rect *boundsRect, SInt32 value,
                             SInt32 minimum, SInt32 maximum,
                             ControlSliderOrientation orientation, UInt16 numTickMarks,
                             Boolean liveTracking, ControlActionUPP liveTrackingProc,
                             ControlRef *outControl);
```

Relevant constants are

<i>Parameter</i>	<i>Constants</i>
orientation	kControlSliderPointsDownOrRight
	kControlSliderPointsUpOrLeft
	kControlSliderDoesNotPoint

## Group Boxes—Embedding Control

Group boxes are embedding controls used to group a number of related items. They may be either **primary** or **secondary**.

A group box can be untitled or it can have a text title, a pop-up menu title, or a checkbox title. Group boxes with a pop-up menu title are useful for displaying a variety of related settings in a limited space. Group boxes with a checkbox title are useful for indicating that a group of settings may be deactivated by the user.

Secondary group boxes are generally used for grouping subsidiary information.

Typical group boxes are shown in Fig 7.

## Variants and Control Definition IDs

The group box CDEF resource ID is 10. The six available variants and their control definition IDs are as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
Primary group box, text title.	0	160 kControlGroupBoxTextTitleProc
Primary group box, checkbox title.	1	161 kControlGroupBoxCheckBoxProc
Primary group box, pop-up button title.	2	162 kControlGroupBoxPopupButtonProc
Secondary group box, text title.	4	164 kControlGroupBoxSecondaryTextTitleProc
Secondary group box, checkbox title.	5	165 kControlGroupBoxSecondaryCheckBoxProc
Secondary group box, pop-up button title.	6	166 kControlGroupBoxSecondaryPopupButtonProc



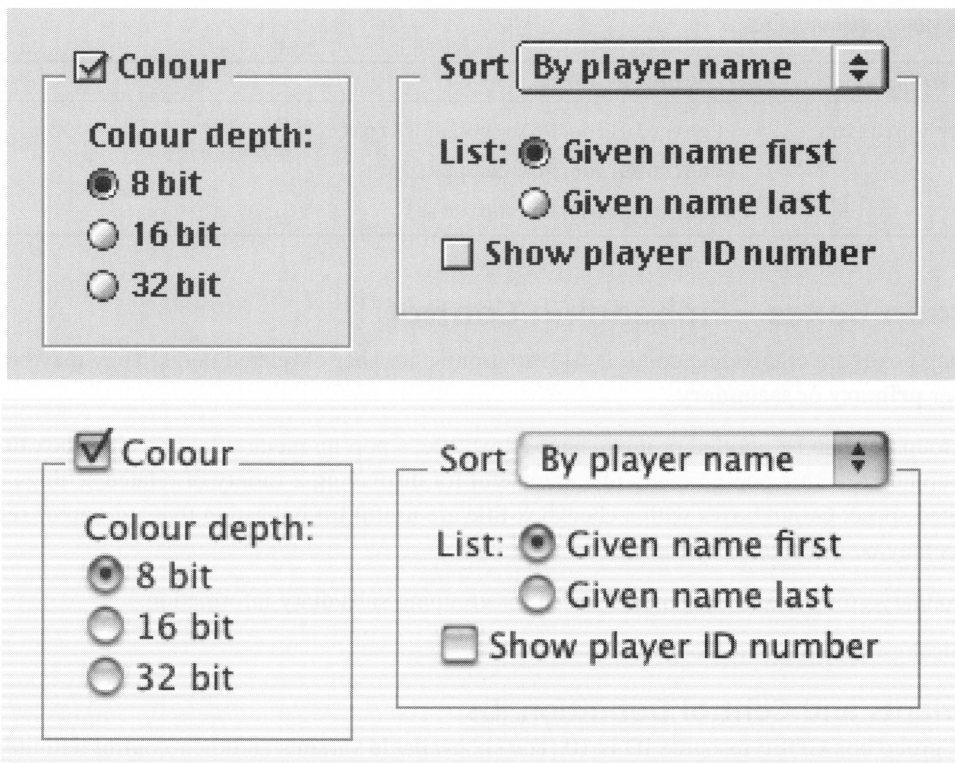


FIG 7 - TYPICAL GROUP BOXES

### Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Ignored if group box has text title If the group box has a checkbox or pop-up button title, same value as the checkbox or pop-up button
Minimum	Ignored if group box has text title. If the group box has a checkbox or pop-up button title, same minimum setting as the checkbox or pop-up button
Maximum	Ignored if group box has text title. If the group box has a checkbox or pop-up button title, same maximum setting as the checkbox or pop-up button

## Control Data Tag Constant

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
kControlGroupBoxMenuRefTag	Gets the menu reference of a group box. <b>Data type returned or set:</b> MenuRef
kControlGroupBoxFontStyleTag	Gets or sets the font style. <b>Data type returned or set:</b> ControlFontStyleRec
kControlGroupBoxTitleRectTag	Gets the rectangle containing the group box title (and any associated control, such as a checkbox). <b>Data type returned:</b> Rect

## Control Part Codes

<i>Constant</i>	<i>Value</i>	<i>Description</i>
kControlNoPart	0	Returned if the group box title is a text title. If the group box title is a checkbox title or a pop-up menu button title, the user tracked completely out of the control.
kControlButtonPart	10	The group box title is a checkbox title and the checkbox was hit. The group box title is a pop-up menu button and the mouse button was released over the button.
kControlMenuPart	2	The group box title is a pop-up menu button and the mouse button was released in the menu.

## Programmatic Creation

Group box controls may be created programmatically using the functions

CreateGroupBoxControl, CreateCheckGroupBoxControl, and CreatePopupGroupBoxControl:

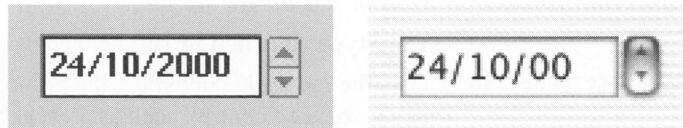
```
OSStatus CreateGroupBoxControl(WindowRef window, const Rect *boundsRect,
                               CFStringRef title, Boolean primary,
                               ControlRef *outControl);
```

```
OSStatus CreateCheckGroupBoxControl(WindowRef window, const Rect *boundsRect,
                                     CFStringRef title, SInt32 initialValue,
                                     Boolean primary, Boolean autoToggle,
                                     ControlRef *outControl);
```

```
OSStatus CreatePopupGroupBoxControl(WindowRef window, const Rect *boundsRect,
                                     CFStringRef title, Boolean primary, SInt16 menuID,
                                     Boolean variableWidth, SInt16 titleWidth,
                                     SInt16 titleJustification, Style titleStyle,
                                     ControlRef *outControl);
```

## Clock

Clock controls are a combination of an edit text control and little arrows that display date or time. The displayed date and time may be changed using the little arrows or by typing in the edit text control. Fig 8 shows a clock control displaying a date.



**FIG 8 - CLOCK CONTROL DISPLAYING DATE**

The clock control supports keyboard navigation and keyboard focus. If the control is made inactive, the user will be unable to change the displayed date or time values; however the correct date and time will continue to be displayed.

### Variants and Control Definition IDs

The clock control CDEF resource ID is 15. The four available variants and their control definition ID are follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
Clock control displaying hour/minutes.	0	240 kControlClockTimeProc
Clock control displaying hours/minutes/seconds.	1	241 kControlClockTimeSecondsProc
Clock control displaying date/month/year.	2	242 kControlClockDateProc
Clock control displaying month/year.	3	243 kControlClockMonthYearProc

### Control Values

<i>Control Value</i>	<i>Content</i>
Initial	One or more of the clock value flags. (See “Clock Value Flag Constants.”) Reset to 0 after creation.
Minimum	Reserved. Set to 0.
Maximum	Reserved. Set to 0.

## Clock Value Flag Constants

<i>Constant</i>	<i>Value</i>	<i>Description</i>
kControlClockNoFlags	0	Indicates that clock is editable but does not display the current “live” time.
kControlClockIsDisplayOnly	1	When only this bit is set, the clock is not editable. When this bit and the kControlClockIsLive bit is set, the clock automatically updates on idle (clock will have the current time).
kControlClockIsLive	2	When only this bit is set, the clock automatically updates on idle and any changes to the clock affect the system clock. When this bit and the kControlClockIsDisplayOnly bit is set, the clock automatically updates on idle (clock will have the current time), but is not editable.

## Control Data Tag Constant

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
kControlClockLongDateTag	Gets or sets the clock control’s time or date. <b>Data type returned or set:</b> LongDateRec structure.
kControlClockFontStyleTag	Gets or sets the font style. <b>Data type returned or set:</b> ControlFontStyleRec
kControlClockAnimatingTag	Starts and stops clock animation. Use only if a call to GetControlFeatures reveals that the control’s kControlIdlesWithTimer flag is set. <b>Data type set:</b> Boolean

## Control Part Codes

<i>Constant</i>	<i>Value</i>	<i>Description</i>
kControlClockPart	8	Event occurred in a clock control.
kControlClockHourDayPart	9	Event occurred in the part that contains the hour.
kControlClockMinuteMonthPart	10	Event occurred in the part that contains the minute or the month.

<i>Constant</i>	<i>Value</i>	<i>Description</i>
kControlClockSecondYearPart	11	Event occurred in the part that contains the second or the year.
kControlClockAMPMPart	12	Event occurred in the part that contains the AM/PM information.

## Programmatic Creation

Clock controls may be created programmatically using the function `CreateClockControl`:

```
OSStatus CreateClockControl(WindowRef window, const Rect *boundsRect,
                           ControlClockType clockType, ControlClockFlags clockFlags,
                           ControlRef *outControl);
```

Relevant constants are

<i>Parameter</i>	<i>Constants</i>
clockType	kControlClockTypeHourMinute kControlClockTypeHourMinuteSecond kControlClockTypeMonthDayYear kControlClockTypeMonthYear
clockFlags	See “Clock Value Flag Constants.”

## Progress and Relevance Bars

Progress bars are used to indicate capacity or the current status of a lengthy operation. Two types of Progress bars can be used: an **indeterminate progress bar**, which shows that an operation is occurring but does not indicate its current status; a **determinate progress bar**, which shows how much of the operation has been completed. The two types are shown in Fig 9.

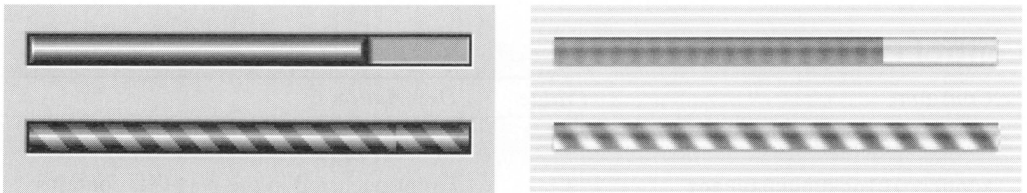


FIG 9 - PROGRESS INDICATORS

On Mac OS 8/9, the progress bar control is often used as a **relevance bar**. On Mac OS X, a separate relevance bar control, which can only be created programmatically, is available.

## Variants and Control Definition IDs

The progress bar CDEF resource ID is 5. The two available variants and their control definition IDs are as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
Progress bar. To make the control determinate or indeterminate, set the kControlProgressBarIndeterminateTag constant. (See “Control Data Tag Constant Relevant to Progress bars.”)	0	80 kControlProgressBarProc
Relevance bar.	1	81 kControlRelevanceBarProc

## Progress Bar Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Appropriate value between –32768 and 32767
Minimum	–32768 to 32767
Maximum	–32768 to 32767

## Control Data Tag Constant

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
kControlProgressBarIndeterminateTag	Gets or sets whether a progress bar is determinate or indeterminate.  <b>Data type returned or set:</b> Boolean. If true, switches to an indeterminate progress bar. If false, switches to an determinate progress bar.
kControlProgressBarAnimatingTag	Starts and stops progress bar animation. Use only if a call to GetControlFeatures reveals that the control’s kControlIdlesWithTimer flag is set.  <b>Data type returned or set:</b> Boolean

Programmatic Creation

Progress bars may be created programmatically using the function `CreateProgressBarController`:

```
OSStatus CreateProgressBarController(WindowRef window,const Rect *boundsRect,SInt32 value,
                                   SInt32 minimum,SInt32 maximum,Boolean indeterminate,
                                   ControlRef *outControl);
```

On Mac OS X only, relevance bars may be created programmatically using the function `CreateRelevanceBarController`:

```
OSStatus CreateRelevanceBarController(WindowRef window,const Rect *boundsRect,SInt32 value,
                                     SInt32 minimum,SInt32 maximum,
                                     ControlRef *outControl);
```

Little Arrows

The little arrows control which consists of two opposing arrows, provide a means of increasing or decreasing values (see Fig 10). They should always be accompanied by a label that identifies the content to which the control relates.

The displayed value is incremented or decremented by one unit of change when the user clicks the up or down arrow. If the user clicks an arrow and holds the mouse button down, the value increases or decreases until the user releases the button. The unit of change should depend on the content.

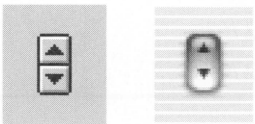


FIG 10 - LITTLE ARROWS

Variant and Control Definition ID

The little arrows CDEF resource ID is 6. The one available variant and its control definition ID is as follows:

Variant	Var Code	Control Definition ID
Little arrows	0	96 kControlLittleArrowsProc



## Control Values

Control Value	Content
Initial	Appropriate value between -32768 and 32767
Minimum	-32768 and 32767
Maximum	-32768 and 32767

## Control Part Codes

Constant	Value	Description
kControlUpButtonPart	20	Event occurred in up arrow
kControlDownButtonPart	21	Event occurred in down arrow

## Programmatic Creation

Little arrows controls may be created programmatically using the function

CreateLittleArrowsControl:

```
OSStatus CreateLittleArrowsControl(WindowRef window, const Rect *boundsRect, Sint32 value,  
                                   Sint32 minimum, Sint32 maximum, Sint32 increment,  
                                   ControlRef *outControl);
```

## Disclosure Triangles

Disclosure triangles are used to display and hide additional information in a window and also to reveal the contents of folders in list views (see Fig 11). They have two possible values: 0 for collapsed and 1 for expanded. The first click on the control rotates the triangle downwards.

The second click rotates the triangle back to the original orientation.

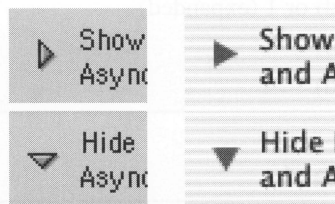


FIG 11 - DISCLOSURE TRIANGLES

## Variants and Control Definition IDs

The disclosure triangle CDEF resource ID is 4. The four available variants and their control definition ID is as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>	
Disclosure triangle.	0	64	kControlTriangleProc
Left-facing disclosure triangle.	1	65	kControlTriangleLeftFacingProc
Auto-tracking disclosure triangle. This variant maintains its last value, so it knows what transition is taking place when a SetControlValue is called on it (expanded to collapsed, or vice versa). (See “Control Data Tag Constants.”)	2	66	kControlTriangleAutoToggleProc
Left-facing, auto-tracking disclosure triangle.	3	67	kControlTriangleLeftFacingAutoToggleProc

## Control Values

<i>Control Value</i>	<i>Content</i>
Initial	0 (collapsed) or 1 (expanded)
Minimum	0 (collapsed)
Maximum	1 (expanded)

## Control Data Tag Constant

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
kControlTriangleLastValueTag	Gets or sets the last value of a disclosure triangle. Used primarily for setting up a disclosure triangle properly when using the kControlTriangleAutoToggleProc variant. <b>Data type returned or set:</b> SInt16

## Helper Function

The helper function `SetDisclosureTriangleLastValue` may be used in lieu of `SetControlData` with the `kControlTriangleLastValueTag` control data tag.

## Control Part Codes

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kControlTrianglePart</code>	4	Event occurred in a disclosure triangle

## Programmatic Creation

Disclosure triangle controls may be created programmatically using the function `CreateDisclosureTriangleControl`:

```
OSStatus CreateDisclosureTriangleControl(WindowRef window, const Rect *boundsRect,
                                       ControlDisclosureTriangleOrientation orientation,
                                       CFStringRef title, SInt32 initialValue,
                                       Boolean drawTitle, Boolean autoToggles,
                                       ControlRef *outControl);
```

Relevant constants are

<i>Parameter</i>	<i>Constants</i>
orientation	<code>kControlDisclosureTrianglePointDefault</code>
	<code>kControlDisclosureTrianglePointRight</code>
	<code>kControlDisclosureTrianglePointLeft</code>

## Picture

Picture controls display pictures.

## Variants and Control Definition IDs

The picture control CDEF resource ID is 19. The two available variants and their control definition IDs are as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
Picture control.	0	304 <code>kControlPictureProc</code>
Non-tracking picture control. If hit, immediately returns the control part code <code>kControlNoPart</code> and does not track.	1	305 <code>kControlPictureNoTrackProc</code>

## Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Resource ID of the 'PICT' resource you wish to display. Reset to 0 after creation.
Minimum	Reserved. Set to 0.
Maximum	Reserved. Set to 0.

## Control Data Tag Constant

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
kControlPictureHandleTag	Sets picture <b>Data type set:</b> PicHandle

## Control Part Codes

<i>Constant</i>	<i>Value</i>	<i>Description</i>
kControlPicturePart	6	Event occurred in a picture control

## Programmatic Creation

Picture controls may be created programmatically using the function `CreatePictureControl`:

```
OSStatus CreatePictureControl(WindowRef window, const Rect *boundsRect,
                             const ControlButtonContentInfo *content, Boolean dontTrack,
                             ControlRef *outControl);
```

## Icon

Icon controls display color icons and icons from an icon suite.

A non-tracking variant is available for use in dialogs that have an embedding hierarchy and want an icon. This variant just returns the part hit immediately; it does not actually track the mouse.

## Variants and Control Definition IDs

The icon CDEF resource ID is 20. The four available variants and their control definition IDs are as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>	
Icon control.	0	320	kControlIconProc
Non-tracking icon. If hit, immediately returns the control part code kControlIconPart without tracking.	1	321	kControlIconNoTrackProc
Icon suite.	2	322	kControlIconSuiteProc
Non-tracking icon suite. If hit, immediately returns the control part code kControlIconPart without tracking.	3	323	kControlIconSuiteNoTrackProc
Supports all standard types of icon-based content.	4	324	kControlIconRefProc
Supports all standard types of icon-based content. Non-tracking variant.	5	325	kControlIconRefNoTrackProc

Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Resource ID of the 'cicn', 'ICON', or icon suite resource you wish to display. (The icon suite variant looks for an icon suite. If not found, it looks for a 'cicn' or 'ICON' resource.) Reset to 0 after creation.
Minimum	Reserved. Set to 0.
Maximum	Reserved. Set to 0.

### Control Data Tag Constants

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
kControlIconTransformTag	Gets or sets a transform that is added to the standard transform for an icon. (See Chapter 13.) <b>Data type returned or set:</b> IconTransformType
kControlIconAlignmentTag	Gets or sets an icon's position. (See Chapter 13.) <b>Data type returned or set:</b> IconAlignmentType
kControlIconResourceIDTag	Gets or sets the resource ID of the icon to use. <b>Data type returned or set:</b> Sint16
kControlIconContentTag	Gets or sets the type of content to be used in an icon control. <b>Data type returned or set:</b> ControlButtonContentInfo

### Control Part Codes

<i>Constant</i>	<i>Value</i>	<i>Description</i>
kControlIconPart	7	Event occurred in an icon control

### Programmatic Creation

Icon controls may be created programmatically using the function `CreateIconControl`:

```
OSStatus CreateIconControl(WindowRef window, const Rect *boundsRect,
                           const ControlButtonContentInfo *icon, Boolean dontTrack,
                           ControlRef *outControl);
```

### Window Headers—Embedding Control

Window headers are rectangular embedding controls which should be located at the top of a window's content region and used to provide information about the window's contents.

The list view header variant is similar to the main variant, but removes the line that separates a standard window header from the content area.

### Variants and Control Definition IDs

The window header CDEF resource ID is 21. The two available variants and their control definition IDs are as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
Window header	0	336 kControlWindowHeaderProc
Window list view header	1	337 kControlWindowListViewHeaderProc

## Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Reserved. Set to 0.
Minimum	Reserved. Set to 0.
Maximum	Reserved. Set to 0.

## Programmatic Creation

Window header controls may be created programmatically using the function `CreateWindowHeaderControl`:

```
OSStatus CreateWindowHeaderControl(WindowRef window, const Rect *boundsRect,
                                   Boolean isListHeader, ControlRef *outControl);
```

## Placard—Embedding Control

Placards are rectangular embedding controls used to display information. They can also be used simply as background fill for a control area. Typically, placards are used as a small information panel placed at the bottom of a window.

## Variants and Control Definition IDs

The placard CDEF resource ID is 14. The one available variant and its control definition ID is as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
Placard	0	224 kControlPlacardProc

Future versions will provide a push button variant.

## Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Reserved. Set to 0.
Minimum	Reserved. Set to 0.
Maximum	Reserved. Set to 0.



## Programmatic Creation

Placard controls may be created programmatically using the function `CreatePlacardControl`:

```
OSStatus CreatePlacardControl(WindowRef window, const Rect *boundsRect,
                             ControlRef *outControl);
```

## Static Text

Static text controls display static text, that is, text that cannot be changed by the user.

### Variant and Control Definition ID

The static text control CDEF resource ID is 18. The one available variant and its control definition ID is as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
Static text control	0	288 kControlStaticTextProc

## Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Reserved. Set to 0.
Minimum	Reserved. Set to 0.
Maximum	Reserved. Set to 0.

## Control Data Tag Constants

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
kControlStaticTextTextTag	Gets or sets text. <b>Data type returned or set:</b> character buffer
kControlStaticTextTextHeightTag	Gets the height of text. <b>Data type returned or set:</b> SInt16
kControlStaticTextStyleTag	Gets or sets the font style. <b>Data type returned or set:</b> ControlFontStyleRec
kControlStaticTextTruncTag	Gets or sets how text is truncated at end of a line. <b>Data type returned or set:</b> TruncCode. The value <code>truncEnd</code> indicates that characters are truncated off the end of the string. <code>truncMiddle</code> indicates that characters are truncated from the middle of the string. The default is <code>-1</code> , which indicates that no truncation occurs and, instead, the text is wrapped.

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
kControlStaticTextCFStringRefTag	Gets or sets a CFStringRef reference.
<b>Data type returned or set:</b> CFStringRef	

Programmatic Creation

Static text controls may be created programmatically using the function `CreateStaticTextControl`:

```
OSStatus CreateStaticTextControl(WindowRef window,const Rect *boundsRect,
                                CFStringRef text,const ControlFontStyleRec *style,
                                ControlRef * outControl);
```

Separator Lines

Separator lines are vertical or horizontal lines used to visually separate groups of controls. The orientation of the bounding rectangle determines the orientation of the line.

Variants and Control Definition IDs

The separator line CDEF resource ID is 9. The one available variant and its control definition ID is as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
Separator line	0	144 kControlSeparatorLineProc

Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Reserved. Set to 0.
Minimum	Reserved. Set to 0.
Maximum	Reserved. Set to 0.

Programmatic Creation

Separator line controls may be created programmatically using the function `CreateSeparatorControl`:

```
OSStatus CreateSeparatorControl(WindowRef window,const Rect *boundsRect,
                                ControlRef *outControl);
```

Pop-up Arrows

The pop-up arrow control simply draws the pop-up glyph.

## Variants and Control Definition IDs

The pop-up arrow CDEF resource ID is 12. The eight available variants and their control definition IDs are as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>	
Large, east-facing pop-up arrow	0	192	kControlPopupArrowEastProc
Large, west-facing pop-up arrow	1	193	kControlPopupArrowWestProc
Large, north-facing pop-up arrow	2	194	kControlPopupArrowNorthProc
Large, south-facing pop-up arrow	3	195	kControlPopupArrowSouthProc
Small, east-facing pop-up arrow	4	196	kControlPopupArrowSmallEastProc
Small, west-facing pop-up arrow	5	197	kControlPopupArrowSmallWestProc
Small, north-facing pop-up arrow	6	198	kControlPopupArrowSmallNorthProc
Small, south-facing pop-up arrow	7	199	kControlPopupArrowSmallSouthProc

## Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Reserved. Set to 0.
Minimum	Reserved. Set to 0.
Maximum	Reserved. Set to 0.

## Programmatic Creation

Pop-up arrow controls may be created programmatically using the function `CreatePopupArrowControl`:

```
OSStatus CreatePopupArrowControl(WindowRef window, const Rect *boundsRect,
                                ControlPopupArrowOrientation orientation,
                                ControlPopupArrowSize size, ControlRef *outControl);
```

Relevant constants are

Parameter	Constants
orientation	kControlPopupArrowOrientationEast
	kControlPopupArrowOrientationWest
	kControlPopupArrowOrientationNorth
	kControlPopupArrowOrientationSouth
size	kControlPopupArrowSizeNormal
	kControlPopupArrowSizeSmall

## Radio Groups—Embedding Control

Radio groups are embedding controls which relieve your application of much of the work involved in managing a group of radio buttons (or bevel buttons that are intended to operate like radio buttons). For example, if a group of radio buttons are embedded in a radio group control, the radio group control handles the checking and unchecking of the radio buttons when the user clicks on one of them. The current value of the radio group control represents the radio button currently selected.

### Variant and Control Definition ID

The radio group CDEF resource ID is 26. The one available variant and its control definition ID is as follows:

Variant	Var Code	Control Definition ID
Radio group	0	416 kControlRadioGroupProc

## Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Set to 0 on creation. Reset to the index of the currently selected embedded radio control after creation. If the currently selected control does not support radio behavior, this value will be set to 0 and the control will be deselected. To deselect all controls, set to 0.
Minimum	Set to 0.
Maximum	Set to 0 on creation. Reset to the number of embedded controls as controls are added.

## Control Part Codes

<i>Constant</i>	<i>Value</i>	<i>Description</i>
kControlRadioGroupPart	27	Event occurred in a radio group

## Programmatic Creation

Radio group controls may be created programmatically using the function `CreateRadioGroupControl`:

```
OSStatus CreateRadioGroupControl(WindowRef window, const Rect *boundsRect,
                                ControlRef *outControl);
```

## Chasing Arrows

Chasing arrows are a simple animation used to indicate that an asynchronous background process is occurring, in other words a process which does not display a dialog containing a progress bar (see Fig 12).

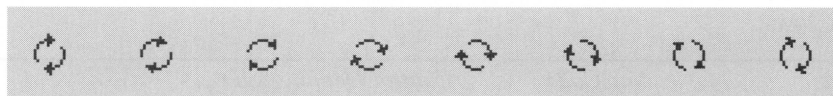


FIG 12 - FRAMES OF A CHASING ARROWS ANIMATION

## Variant and Control Definition ID

The chasing arrows CDEF resource ID is 7. The one available variant and its control definition ID is as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
Chasing arrows	0	112 kControlChasingArrowsProc

Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Reserved. Set to 0.
Minimum	Reserved. Set to 0.
Maximum	Reserved. Set to 0.

Control Data Tag Constant

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
kControlChasingArrowsAnimatingTag	Starts and stops chasing arrows animation. Use only if a call to GetControlFeatures reveals that the control’s kControlIdlesWithTimer flag is set.  <b>Data type returned or set:</b> Boolean.

Programmatic Creation

Asynchronous arrow controls may be created programmatically using the function CreateChasingArrowsControl:

```
OSStatus CreateChasingArrowsControl(WindowRef window, const Rect *boundsRect,
                                     ControlRef *outControl);
```

User Panes—Embedding Control

The user pane has two main uses:

- It can be used as an embedding control, that is, other controls may be embedded within it. It is thus particularly useful for grouping together the controls belonging to an individual pane of a tab control or pop-up button group box.
- It provides a way to hook in application-defined (callback) functions, known as **user pane functions**, which perform actions such as drawing, hit testing, tracking, and so on.

Variants and Control Definition IDs

The user pane CDEF resource ID is 16. The one available variant and its control definition ID is as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
User pane	0	256 kControlUserPaneProc

## Control Values

<i>Control Value</i>	<i>Content</i>
Initial	One or more of the control feature constants. (See “Defining Your Own User Pane Functions.”) Reset to 0 after creation.
Minimum	Ignored. After user pane creation, reset to a setting between –32768 to 32767.
Maximum	Ignored. After user pane creation, reset to a setting between –32768 to 32767.

## Control Data Tag Constants

The control data tag constants relevant to user panes all relate to user pane functions. See *Defining Your Own User Pane Function*.

## Programmatic Creation

User Pane controls may be created programmatically using the function `CreateUserPaneControl`:

```
OSStatus CreateUserPaneControl(WindowRef window, const Rect *boundsRect,
                               UInt32 features, ControlRef *outControl);
```

## Scrolling Text Box

The scrolling text box implements a scrolling box of non-editable text. There are two variants:

- The standard variant, which has a scroll bar.
- The auto-scrolling variant, which does not have a scroll bar. This variant needs two pieces of information to work: the delay (in ticks) before the scrolling starts; the time (in ticks) between scrolls. By default, the text will scroll one pixel at a time, although this may be changed via `SetControlData`.

## Variants and Control Definition IDs

The scrolling text box CDEF resource ID is 27. The two available variants and their control definition IDs are as follows:



<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
Standard	0	432 kControlScrollTextBoxProc
Auto-scrolling	1	433 kControlScrollTextBoxAutoScrollProc

## Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Resource ID of a 'TEXT' and, optionally, a 'styl' resource.
Minimum	For the standard variant, set to 0.  For the auto-scrolling variant, the delay (in ticks) before scrolling begins. (This delay is also used between when the scrolling completes and when it begins again.)
Maximum	For the standard variant, set to 0.  For the auto-scrolling variant, the delay (in ticks) between each unit of scrolling.

## Control Data Tag Constants

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
KControlScrollTextBoxDelayBeforeAutoScrollTag	Gets or sets the number of ticks of delay before the initial scrolling of an auto-scrolling text box begins.  <b>Data type returned or set:</b> UInt32
KControlScrollTextBoxDelayBetweenAutoScrollTag	Gets or sets the number of ticks of delay between each unit of scrolling in an auto-scrolling text box.  <b>Data type returned or set:</b> UInt32
KControlScrollTextBoxAutoScrollAmountTag	Gets or sets the number of pixels by which an auto scrolling text box scrolls. (The default is 1.)  <b>Data type returned or set:</b> UInt16
kControlScrollTextBoxContentsTag	Sets the ID of a 'TEXT' resource and, optionally, a 'styl' resource, to be used as the content of a standard or auto-scrolling text box.  <b>Data set:</b> Sint16

## Programmatic Creation

Scrolling text box controls may be created programmatically using the function `CreateScrollingTextBoxControl`:

```
OSStatus CreateScrollingTextBoxControl(WindowRef window, const Rect *boundsRect,
                                       Sint16 contentResID, Boolean autoScroll,
                                       UInt32 delayBeforeAutoScroll,
                                       UInt32 delayBetweenAutoScroll,
                                       UInt16 autoScrollAmount, ControlRef *outControl);
```

## Disclosure Button

The disclosure button is available only on Mac OS X, and can only be created programmatically using the function `CreateDisclosureButtonControl` (see Fig 13):

```
OSStatus CreateDisclosureButtonControl(WindowRef inWindow, const Rect *inBoundsRect,
                                       Sint32 inValue, Boolean inAutoToggles,
                                       ControlRef * outControl);
```



FIG 13 - DISCLOSURE BUTTON

The height of the button is fixed at 20 pixels. The button will be as wide as the specified rectangle and will be centered in that rectangle vertically.

Relevant constants are:

<i>Parameter</i>	<i>Constants</i>
<code>inValue</code>	<code>kControlDisclosureButtonClosed</code> <code>kControlDisclosureButtonDisclosed</code>

## Edit Unicode Text

The edit Unicode text control is available only on Mac OS X, and can only be created programmatically using the function `CreateEditUnicodeTextControl`:

```
OSStatus CreateEditUnicodeTextControl(WindowRef window, const Rect *boundsRect,
                                       CFStringRef text, Boolean isPassword,
                                       const ControlFontStyleRec *style,
                                       ControlRef *outControl);
```

The control data tags applicable to the edit text control also apply to the edit Unicode text control, except that the `kControlEditTextTEHandleTag` tag must not be used.

## Round Button

The round button is available only on Mac OS X, and can only be created programmatically using the function `CreateRoundButtonControl`:

```
OSStatus CreateRoundButtonControl(WindowRef nWindow, const Rect *inBoundsRect,
                                   ControlRoundButtonSize inSize,
                                   ControlButtonContentInfo *inContent,
                                   ControlRef *outControl);
```

Relevant constants are

Parameter	Constants
inSize	kControlRoundButtonNormalSize (20-pixel diameter)
	kControlRoundButtonLargeSize (25-pixel diameter)

## Control Data Tag Constants

Control Data Tag Constant	Meaning and Data Type Returned or Set
kControlRoundButtonContentTag	Sets button content <b>Data type set:</b> ControlButtonContentInfo
kControlRoundButtonSizeTag	Sets button size <b>Data type set:</b> ControlRoundButtonSize

## Small Versions of Controls

Human Interface Guidelines permit the use of small versions of certain controls, which should only be used when space is at a premium. Full size and small controls should not be mixed in the same window.

The following lists those controls described in this chapter that are available in small versions, and describes how to create them.

Control	Mac OS X	Mac OS 8/9
Tab	Pass kControlTabSizeSmall in <code>CreateTabsControl</code> call or use a small variant if creating from a 'CNTL' resource.	Pass kControlTabSizeSmall in <code>CreateTabsControl</code> call or use a small variant if creating from a 'CNTL' resource.

<i>Control</i>	<i>Mac OS X</i>	<i>Mac OS 8/9</i>
	Alternatively, if the control is created large, call <code>SetControlData</code> with the <code>kControlSizeTag</code> tag.	
Edit text	Make the control's rectangle 13 pixels high and call <code>SetControlFontStyle</code> to set the control's font to the small system font.	Make the control's rectangle 13 pixels high and call <code>SetControlFontStyle</code> to set the control's font to the small system font.
Slider	Call <code>SetControlData</code> with the <code>kControlSizeTag</code> tag.	(Not available.)
Pop-up arrow	Pass <code>kControlPopupArrowSizeSmall</code> in <code>CreatePopupArrowControl</code> call or use a small variant if creating from a 'CNTL' resource.  Alternatively, if the control is created large, call <code>SetControlData</code> with the <code>kControlSizeTag</code> to make it small.	Pass <code>kControlPopupArrowSizeSmall</code> in <code>CreatePopupArrowControl</code> call or use a small variant if creating from a 'CNTL' resource.
Round button	Call <code>SetControlData</code> with the <code>kControlSizeTag</code> tag.	(Not available.)

## Idle Processing

The following four controls need to perform idle processing for the reasons indicated:

<i>Control</i>	<i>Reason For Idle Processing</i>
Progress bar (indeterminate variant)	Animate the indicator
Clocks (when the <code>kControlClockIsLive</code> clock value flag constant is used)	Update the clock
Chasing arrows	Animate the arrows
Edit text controls	Cause <code>TextEdit</code> to be called to blink the insertion point caret
Scrolling text box (auto-scrolling variant)	Scroll the text automatically

When these controls are displayed in a document window, your application may need to call `IdleControls` at the appropriate interval in your event loop, otherwise the animations, and so on, will not occur. `IdleControls` sends a particular message to the CDEF, which responds appropriately.

The call to `IdleControls` is not necessary on Mac OS X because Mac OS X controls idle themselves automatically using their own internal timers. However, as of the time of writing, the call is necessary on Mac OS 8/9 because controls on Mac OS 8/9 do not yet have internal timers.

When these controls are displayed in a dialog on Mac OS 8/9, `ModalDialog` calls `IdleControls` for you.

You can determine whether a control has an internal timer by calling `GetControlFeatures` and testing for the `kControlIdlesWithTimer` bit.

## Defining Your Own Key Filter Function

You can attach a **key filter function** to edit text controls to filter key strokes or modify them on return. Your key filter function can change the keystroke, leave it alone, or block the CDEF from receiving it. For example, an edit text control could use a key filter function to allow only numeric values to be input in its field.

You would declare your key filter function as follows:

```
ControlKeyFilterResult myKeyFilterFunction(ControlRef controlRef, SInt16* keyCode,
                                           SInt16 *charCode, EventModifiers *modifiers);
```

The Control Manager defines the data type `ControlKeyFilterUPP` to identify the universal procedure pointer for this function:

```
typedef STACK_UPP_TYPE(ControlKeyFilterProcPtr) ControlKeyFilterUPP;
```

As stated in the “Edit Text” section, the control data tag constant for getting and setting a key filter function is `kControlKeyFilterTag` and the data type returned or set is `ControlKeyFilterUPP`.

## Example

The following example relates to an edit text control and assumes a key filter function named `numericFilter`.

```
#define kLeftArrow 0x1C
#define kRightArrow 0x1D
#define kUpArrow 0x1E
#define kDownArrow 0x1F
#define kBackspace 0x08
...

ControlKeyFilterUPP numericFilterUPP;
ControlRef controlHdl;
...

// ..... get universal procedure pointer

numericFilterUPP = NewControlKeyFilterProc(numericFilter);

// ..... attach key filter function to the control

GetDialogItemAsControl(dialogPtr,itemNumber,&controlHdl);
SetControlData(controlHdl,kControlNoPart,kControlEditTextKeyFilterTag,
    sizeof(numericFilterUPP),&numericFilterUPP);

...

// ***** numericFilter
//
// This function will be called each time the edit text control receives a keystroke.
// Keystrokes that are to be accepted must return kControlKeyFilterPassKey. Keystrokes
// that are to be blocked must return kControlKeyFilterBlockKey. This function blocks
// all but the numeric keys, the "dash" key, and the arrow keys.

ControlKeyFilterResult numericFilter(ControlRef control,SInt16 *keyCode,
    SInt16 *charCode,SInt16 *modifiers)
{
    if(((char) *charCode >= '0') && ((char) *charCode <= '9'))
        return kControlKeyFilterPassKey;

    switch(*charCode)
```

```

{
    case '-':
    case kLeftArrow:
    case kRightArrow:
    case kUpArrow:
    case kDownArrow:
    case kBackspace:
        return kControlKeyFilterPassKey;
        break;

    default:
        SysBeep(10);
        return kControlKeyFilterBlockKey;
        break;
}
}

```

## Defining Your Own Edit Text Validation Function

A key filter function, however, does not cater for the case of pasting text to an edit text item. Accordingly, you will ordinarily want to combine an **edit text validation function** with the key filter function for a specific edit text control.

You would declare your edit text validation function as follows:

```
void myEditTextValidationFunction(ControlRef controlHdl);
```

The following example ensures that, if a user supplied filename pasted to the edit text item contains one or more colons, those colons will be replaced with dashes.

```

ControlEditTextValidationUPP editTextValidatorUPP;
ControlRef controlHdl;
...

// ..... get universal procedure pointer

editTextValidatorUPP = NewControlEditTextValidationProc(editTextValidator);

// ..... attach edit text validation function to the control

GetDialogItemAsControl(dialogPtr, iEditText1, &controlHdl);
SetControlData(controlHdl, kControlNoPart, kControlEditTextValidationProcTag,
    sizeof(editTextValidatorUPP), &editTextValidatorUPP);
...

void editTextValidator(ControlRef controlHdl)
{
    Str31 theText;
    Size actualSize;
    UInt8 a;

```



```

// ..... Get the text to be examined from the control

GetControlData(controlHdl,kControlNoPart,kControlEditTextTextTag,sizeof(theText) -1,
               (Ptr) &theText[1],&actualSize);

// ..... Set the length byte to the
// ..... number of characters in the text, limited to the current maximum for filenames

if(actualSize <= 31)
    theText[0] = actualSize;
else
    theText[0] = 31;

// ..... Replace any colons with dashes

for(a=1;a<=theText[0];a++)
{
    if(theText[a] == ':')
        theText[a] = '-';
}

// ..... You might want to add code
// ..... here to check whether any characters were replaced before bothering to redraw

// ..... Put the replaced text into the control and redraw the control

SetControlData(controlHdl,kControlNoPart,kControlEditTextTextTag,theText[0],
               (Ptr) &theText[1]);

Draw1Control(controlHdl);
}

```

## Defining Your Own User Pane Functions

As previously stated, one of the functions of a user pane is to provide a way to hook in application-defined (callback) functions that perform actions such as drawing, hit testing, tracking, and so on. Such application-defined (callback) functions are called **user pane functions**. User pane functions provide you with the ability to create a custom control without writing your own control definition function.

### User Pane Functions

User pane functions are categorized as follows:

<i>Function</i>	<i>Description</i>
Draw	Draws the content of a user pane control.
Hit test	Returns the part code when a mouse-down event occurs.
Tracking	<p>Tracks a control while the user holds down the mouse button. The function should track the control by repeatedly calling the action function specified in the <code>actionProc</code> parameter until the mouse button is released. When the mouse button is released, your function should return the part code of the control part that was tracked.</p> <p>This function will only be called if you have set the <code>kControlHandlesTracking</code> control feature bit on creation of the user pane control.</p>
Idle	<p>Performs idle processing.</p> <p>This function will only be called if you have set the <code>kControlWantsIdle</code> control feature bit on creation of the user pane control.</p>
Key Down	<p>Handles keyboard event processing. The function should handle the key pressed or released by the user and return the part code of the control where the keyboard event occurred.</p> <p>This function will only be called if you've set the <code>kControlSupportsFocus</code> control feature bit on creation of the user pane control.</p>
Activate	<p>Handles activate and deactivate event processing. The function should perform any special processing before the user pane becomes activated or deactivated. For example, it should deactivate its <code>TEHandle</code> or <code>ListHandle</code> if the user pane is about to be deactivated.</p> <p>This function will only be called if you have set the <code>kControlWantsActivate</code> control feature bit on creation of the user pane control.</p>
Focus	<p>Handle keyboard focus. The function is called in response to a change in keyboard focus. It should respond by changing keyboard focus based on the part code passed in the action parameter.</p> <p>This function will only be called if you have set the <code>kControlSupportsFocus</code> control feature bit on creation of the user pane control.</p>
Background	<p>Sets the background color or pattern (only for user panes that support embedding). The function should set the user pane background color or pattern to whatever is appropriate given the bit depth and device type passed in.</p> <p>This function will only be called if you have set the <code>kControlHasSpecialBackground</code> and <code>kControlSupportsEmbedding</code> control feature bits on creation of the user pane control.</p>

## Control Data Tag Constants and Universal Procedure Pointers

Once you have provided a user pane function, you call `SetControlData` with the control data tag constant representing the user pane function you want to set passed in the `inTagName` parameter and a universal procedure pointer to the user pane function passed in the `inData` parameter.

### Control Data Tag Constants

The control data tag constants relating to user pane functions are as follows:

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
<code>kControlUserPaneDrawProcTag</code>	Gets or sets a drawing function. Indicates that the Control Manager needs to draw a control.  <b>Data type returned or set:</b> <code>ControlUserPaneDrawingUPP</code>
<code>kControlUserPaneHitTestProcTag</code>	Gets or sets a hit-testing function. Indicates that the Control Manager needs to determine if a control part was hit.  <b>Data type returned or set:</b> <code>ControlUserPaneHitTestUPP</code>
<code>kControlUserPaneTrackingProcTag</code>	Gets or sets a tracking function. The tracking function will be called when a control definition function returns the <code>kControlHandlesTracking</code> feature bit in response to a <code>kControlMsgGetFeatures</code> message. Indicates that a user pane handles its own tracking.  <b>Data type returned or set:</b> <code>ControlUserPaneTrackingUPP</code>
<code>kControlUserPaneIdleProcTag</code>	Gets or sets an idle function. The idle function will be called when a control definition function returns the <code>kControlWantsIdle</code> feature bit in response to <code>kControlMsgGetFeatures</code> message. Indicates that a user pane performs idle processing.  <b>Data type returned or set:</b> <code>ControlUserPaneIdleUPP</code>

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
<code>kControlUserPaneKeyDownProcTag</code>	<p>Gets or sets a key down function. The key down function will be called when a control definition function returns the <code>kControlSupportsFocus</code> feature bit in response to a <code>kControlMsgGetFeatures</code> message. Indicates that a user pane performs keyboard event processing.</p> <p><b>Data type returned or set:</b>  <code>ControlUserPaneKeyDownUPP</code></p>
<code>kControlUserPaneActivateProcTag</code>	<p>Gets or sets an activate function. The activate function will be called when a control definition function returns the <code>kControlWantsActivate</code> feature bit in response to a <code>kControlMsgGetFeatures</code> message. Indicates that a user pane wants to be informed of activate and deactivate events.</p> <p><b>Data type returned or set:</b>  <code>ControlUserPaneActivateUPP</code></p>
<code>kControlUserPaneFocusProcTag</code>	<p>Gets or sets a keyboard focus function. The keyboard focus function will be called when a control definition function returns the <code>kControlSupportsFocus</code> feature bit in response to a <code>kControlMsgGetFeatures</code> message. Indicates that a user pane handles keyboard focus.</p> <p><b>Data type returned or set:</b>  <code>ControlUserPaneFocusUPP</code></p>
<code>kControlUserPaneBackgroundProcTag</code>	<p>Gets or sets a background function. The background function will be called when a control definition function returns the <code>kControlHasSpecialBackground</code> and <code>kControlSupportsEmbedding</code> feature bits in response to a <code>kControlMsgGetFeatures</code> message. Indicates that a user pane can set its background color or pattern.</p> <p><b>Data type returned or set:</b>  <code>ControlUserPaneBackgroundUPP</code></p>

## Creating and Disposing of Universal Procedure Pointers

The following functions create and dispose of universal procedure pointers for user pane functions:

NewControlUserPaneDrawUPP	DisposeControlUserPaneDrawUPP
NewControlUserPaneHitTestUPP	DisposeControlUserPaneHitTestUPP
NewControlUserPaneTrackingUPP	DisposeControlUserPaneTrackingUPP
NewControlUserPaneIdleUPP	DisposeControlUserPaneIdleUPP
NewControlUserPaneKeyDownUPP	DisposeControlUserPaneKeyDownUPP
NewControlUserPaneActivateUPP	DisposeControlUserPaneActivateUPP
NewControlUserPaneFocusUPP	DisposeControlUserPaneFocusUPP
NewControlUserPaneBackgroundUPP	DisposeControlUserPaneBackgroundUPP

## Main Constants, Data Types and Functions

### Constants

#### Control Definition IDs

KControlBevelButtonSmallBevelProc	= 32
KControlBevelButtonNormalBevelProc	= 33
KControlBevelButtonLargeBevelProc	= 34
kControlSliderProc	= 48
kControlSliderLiveFeedback	= (1 << 0)
kControlSliderHasTickMarks	= (1 << 1)
kControlSliderReverseDirection	= (1 << 2)
kControlSliderNonDirectional	= (1 << 3)
kControlTriangleProc	= 64
kControlTriangleLeftFacingProc	= 65
kControlTriangleAutoToggleProc	= 66
kControlTriangleLeftFacingAutoToggleProc	= 67
kControlProgressBarProc	= 80
kControlLittleArrowsProc	= 96
kControlChasingArrowsProc	= 112
kControlTabLargeNorthProc	= 128
kControlTabSmallNorthProc	= 129
kControlTabLargeSouthProc	= 130
kControlTabSmallSouthProc	= 131
kControlTabLargeEastProc	= 132
kControlTabSmallEastProc	= 133
kControlTabLargeWestProc	= 134
kControlTabSmallWestProc	= 135
kControlSeparatorLineProc	= 144
kControlGroupBoxTextTitleProc	= 160
kControlGroupBoxCheckBoxProc	= 161
kControlGroupBoxPopupButtonProc	= 162
kControlGroupBoxSecondaryTextTitleProc	= 164
kControlGroupBoxSecondaryCheckBoxProc	= 165
kControlGroupBoxSecondaryPopupButtonProc	= 166
kControlImageWellProc	= 176
kControlPopupArrowEastProc	= 192
kControlPopupArrowWestProc	= 193

kControlPopupArrowNorthProc	= 194
kControlPopupArrowSouthProc	= 195
kControlPopupArrowSmallEastProc	= 196
kControlPopupArrowSmallWestProc	= 197
kControlPopupArrowSmallNorthProc	= 198
kControlPopupArrowSmallSouthProc	= 199
kControlPlacardProc	= 224
kControlClockTimeProc	= 240
kControlClockTimeSecondsProc	= 241
kControlClockDateProc	= 242
kControlClockMonthYearProc	= 243
kControlUserPaneProc	= 256
kControlEditTextProc	= 272
kControlEditTextDialogProc	= 273
kControlEditTextPasswordProc	= 274
kControlEditTextInlineInputProc	= 276
kControlStaticTextProc	= 288
kControlPictureProc	= 304
kControlPictureNoTrackProc	= 305
kControlIconProc	= 320
kControlIconNoTrackProc	= 321
kControlIconSuiteProc	= 322
kControlIconSuiteNoTrackProc	= 323
kControlIconRefProc	= 324
kControlIconRefNoTrackProc	= 325
kControlWindowHeaderProc	= 336
kControlWindowListViewHeaderProc	= 337
kControlListBoxProc	= 352
kControlListBoxAutoSizeProc	= 353
kControlRadioGroupProc	= 416
kControlScrollTextBoxProc	= 432
kControlScrollTextBoxAutoScrollProc	= 433

## Control Variants

kControlNoVariant	= 0
kControlUsesOwningWindowsFontVariant	= 1 << 3

## Control Part Codes

kControlNoPart	= 0
kControlLabelPart	= 1
kControlMenuPart	= 2
kControlTrianglePart	= 4
kControlEditTextPart	= 5
kControlPicturePart	= 6
kControlIconPart	= 7
kControlClockPart	= 8
kControlClockHourDayPart	= 9
kControlClockMinuteMonthPart	= 10
kControlClockSecondYearPart	= 11
kControlClockAMPMPart	= 12
kControlListBoxPart	= 24
kControlListBoxDoubleClickPart	= 25
kControlImageWellPart	= 26

kControlRadioGroupPart	= 27
kControlButtonPart	= 10
kControlCheckBoxPart	= 11
kControlRadioButtonPart	= 11
kControlUpButtonPart	= 20
kControlDownButtonPart	= 21
kControlPageUpPart	= 22
kControlPageDownPart	= 23
kControlIndicatorPart	= 129
kControlDisabledPart	= 254
kControlInactivePart	= 255

### Bevel Button Graphic Alignment

KControlBevelButtonAlignSysDirection	= -1
KControlBevelButtonAlignCenter	= 0
KControlBevelButtonAlignLeft	= 1
KControlBevelButtonAlignRight	= 2
KControlBevelButtonAlignTop	= 3
KControlBevelButtonAlignBottom	= 4
kControlBevelButtonAlignTopLeft	= 5
kControlBevelButtonAlignBottomLeft	= 6
kControlBevelButtonAlignTopRight	= 7
kControlBevelButtonAlignBottomRight	= 8

### Bevel Button Text Alignment Values

KControlBevelButtonAlignTextSysDirection	= teFlushDefault
KControlBevelButtonAlignTextCenter	= teCenter
KControlBevelButtonAlignTextFlushRight	= teFlushRight
KControlBevelButtonAlignTextFlushLeft	= teFlushLeft

### Bevel Button Text Placement

KControlBevelButtonPlaceSysDirection	= -1
KControlBevelButtonPlaceNormally	= 0
KControlBevelButtonPlaceToRightOfGraphic	= 1
KControlBevelButtonPlaceToLeftOfGraphic	= 2
KControlBevelButtonPlaceBelowGraphic	= 3
KControlBevelButtonPlaceAboveGraphic	= 4

### Bevel Button Behavior

kControlBehaviorPushbutton	= 0
kControlBehaviorToggles	= 0x0100
kControlBehaviorSticky	= 0x0200
kControlBehaviorSingleValueMenu	= 0
kControlBehaviorMultiValueMenu	= 0x4000
kControlBehaviorOffsetContents	= 0x8000
kControlBehaviorCommandMenu	= 0x2000

### Bevel Button Content Type

kControlContentTextOnly	= 0
kControlContentIconSuiteRes	= 1
kControlContentCIconRes	= 2
kControlContentPictRes	= 3



kControlContentIconSuiteHandle	= 129
kControlContentCIconHandle	= 130
kControlContentPictHandle	= 131
kControlContentIconRef	= 132

### Bevel Button Thickness

kControlBevelButtonSmallBevel	= 0
kControlBevelButtonNormalBevel	= 1
kControlBevelButtonLargeBevel	= 2

### Bevel Button Menu Placement

kControlBevelButtonMenuOnBottom	= 0
kControlBevelButtonMenuOnRight	= (1 << 2)

### Tab Size

kControlTabSizeLarge	= 0
kControlTabSizeSmall	= 1

### Tab Direction

kControlTabDirectionNorth	= 0
kControlTabDirectionSouth	= 1
kControlTabDirectionEast	= 2
kControlTabDirectionWest	= 3

### Clock Value Flag Constants

kControlClockNoFlags	= 0
kControlClockIsDisplayOnly	= 1
kControlClockIsLive	= 2

### Control Data Tags

kControlFontStyleTag	= FOUR_CHAR_CODE('font')
kControlKeyFilterTag	= FOUR_CHAR_CODE('fltr')
kControlBevelButtonContentTag	= FOUR_CHAR_CODE('cont')
kControlBevelButtonTransformTag	= FOUR_CHAR_CODE('tran')
kControlBevelButtonTextAlignTag	= FOUR_CHAR_CODE('tali')
kControlBevelButtonTextOffsetTag	= FOUR_CHAR_CODE('toff')
kControlBevelButtonGraphicAlignTag	= FOUR_CHAR_CODE('gali')
kControlBevelButtonGraphicOffsetTag	= FOUR_CHAR_CODE('goff')
kControlBevelButtonTextPlaceTag	= FOUR_CHAR_CODE('tplc')
kControlBevelButtonMenuValueTag	= FOUR_CHAR_CODE('mval')
kControlBevelButtonMenuRefTag	= FOUR_CHAR_CODE('mhnd')
kControlBevelButtonOwnedMenuRefTag	= FOUR_CHAR_CODE('omrf')
kControlBevelButtonKindTag	= FOUR_CHAR_CODE('bebk')
kControlBevelButtonCenterPopUpGlyphTag	= FOUR_CHAR_CODE('pglc')
kControlBevelButtonLastMenuTag	= FOUR_CHAR_CODE('lmnu')
kControlBevelButtonMenuDelayTag	= FOUR_CHAR_CODE('mdly')
kControlBevelButtonScaleIconTag	= FOUR_CHAR_CODE('scal')
kControlTriangleLastValueTag	= FOUR_CHAR_CODE('last')
kControlProgressBarIndeterminateTag	= FOUR_CHAR_CODE('inde')
kControlTabContentRectTag	= FOUR_CHAR_CODE('rect')
kControlTabEnabledFlagTag	= FOUR_CHAR_CODE('enab')
kControlTabFontStyleTag	= kControlFontStyleTag

kControlTabInfoTag	= FOUR_CHAR_CODE('tabi')
kControlGroupBoxMenuHandleTag	= FOUR_CHAR_CODE('mhan')
kControlGroupBoxFontStyleTag	= kControlFontStyleTag
kControlGroupBoxTitleRectTag	= FOUR_CHAR_CODE('trec')
kControlImageWellContentTag	= FOUR_CHAR_CODE('cont')
kControlImageWellTransformTag	= FOUR_CHAR_CODE('tran')
kControlClockLongDateTag	= FOUR_CHAR_CODE('date')
kControlClockFontStyleTag	= kControlFontStyleTag
kControlClockAnimatingTag	= FOUR_CHAR_CODE('anim')
kControlUserItemDrawProcTag	= FOUR_CHAR_CODE('uidp')
kControlUserPaneDrawProcTag	= FOUR_CHAR_CODE('draw')
kControlUserPaneHitTestProcTag	= FOUR_CHAR_CODE('hitt')
kControlUserPaneTrackingProcTag	= FOUR_CHAR_CODE('trak')
kControlUserPaneIdleProcTag	= FOUR_CHAR_CODE('idle')
kControlUserPaneKeyDownProcTag	= FOUR_CHAR_CODE('keyd')
kControlUserPaneActivateProcTag	= FOUR_CHAR_CODE('acti')
kControlUserPaneFocusProcTag	= FOUR_CHAR_CODE('foci')
kControlUserPaneBackgroundProcTag	= FOUR_CHAR_CODE('back')
kControlEditTextStyleTag	= kControlFontStyleTag
kControlEditTextTextTag	= FOUR_CHAR_CODE('text')
kControlEditTextTEHandleTag	= FOUR_CHAR_CODE('than')
kControlEditTextKeyFilterTag	= kControlKeyFilterTag
kControlEditTextSelectionTag	= FOUR_CHAR_CODE('sele')
kControlEditTextPasswordTag	= FOUR_CHAR_CODE('pass')
kControlEditTextLockedTag	= FOUR_CHAR_CODE('lock')
kControlEditTextValidationProcTag	= FOUR_CHAR_CODE('vali')
kControlStaticTextStyleTag	= kControlFontStyleTag
kControlStaticTextTextTag	= FOUR_CHAR_CODE('text')
kControlStaticTextTextHeightTag	= FOUR_CHAR_CODE('thei')
kControlStaticTextTruncTag	= FOUR_CHAR_CODE('trun')
kControlIconTransformTag	= FOUR_CHAR_CODE('trfm')
kControlIconAlignmentTag	= FOUR_CHAR_CODE('algn')
kControlIconResourceIDTag	= FOUR_CHAR_CODE('ires')
kControlIconContentTag	= FOUR_CHAR_CODE('cont')
kControlListBoxListHandleTag	= FOUR_CHAR_CODE('lhan')
kControlListBoxKeyFilterTag	= kControlKeyFilterTag
kControlListBoxFontStyleTag	= kControlFontStyleTag
kControlListBoxDoubleClickTag	= FOUR_CHAR_CODE('dblc')
kControlScrollTextBoxDelayBeforeAutoScrollTag	= FOUR_CHAR_CODE('stdl')
kControlScrollTextBoxDelayBetweenAutoScrollTag	= FOUR_CHAR_CODE('scdl')
kControlScrollTextBoxAutoScrollAmountTag	= FOUR_CHAR_CODE('samt')
kControlScrollTextBoxContentsTag	= FOUR_CHAR_CODE('tres')
kControlRoundButtonContentTag	= FOUR_CHAR_CODE('cont')
kControlRoundButtonSizeTag	= FOUR_CHAR_CODE('size')

### Slider Orientation

kControlSliderPointsDownOrRight	= 0
kControlSliderPointsUpOrLeft	= 1
kControlSliderDoesNotPoint	= 2

### Clock Control Type

kControlClockTypeHourMinute	= 0
kControlClockTypeHourMinuteSecond	= 1
kControlClockTypeMonthDayYear	= 2
kControlClockTypeMonthYear	= 3

## Disclosure Triangle Orientation

kControlDisclosureTrianglePointDefault	= 0
kControlDisclosureTrianglePointRight	= 1
kControlDisclosureTrianglePointLeft	= 2

## Pop-up Arrow Orientation

kControlPopupArrowOrientationEast	= 0
kControlPopupArrowOrientationWest	= 1
kControlPopupArrowOrientationNorth	= 2
kControlPopupArrowOrientationSouth	= 3

## Key Filter Result Codes

kControlKeyFilterBlockKey	= 0
kControlKeyFilterPassKey	= 1

## Control Feature Bits

kControlSupportsGhosting	= 1 << 0
kControlSupportsEmbedding	= 1 << 1
kControlSupportsFocus	= 1 << 2
kControlWantsIdle	= 1 << 3
kControlWantsActivate	= 1 << 4
kControlHandlesTracking	= 1 << 5
kControlSupportsDataAccess	= 1 << 6
kControlHasSpecialBackground	= 1 << 7
kControlGetsFocusOnClick	= 1 << 8
kControlSupportsCalcBestRect	= 1 << 9
kControlSupportsLiveFeedback	= 1 << 10
kControlHasRadioBehavior	= 1 << 11

## Focusing Part Codes

kControlFocusNoPart	= 0
kControlFocusNextPart	= -1
kControlFocusPrevPart	= -2

## Disclosure Button State

kControlDisclosureButtonClosed	= 0
kControlDisclosureButtonDisclosed	= 1

## Round Button Size

kControlRoundButtonNormalSize	= 0
kControlRoundButtonLargeSize	= 2

## Control Feature Bit—Internal Timer

kControlIdlesWithTimer	= 1 << 23
------------------------	-----------

## Control Kind (Mac OS X Only)

kControlKindBevelButton	= FOUR_CHAR_CODE('bevl')
kControlKindImageWell	= FOUR_CHAR_CODE('well')
kControlKindTabs	= FOUR_CHAR_CODE('tabs')
kControlKindEditText	= FOUR_CHAR_CODE('etxt')
kControlKindSlider	= FOUR_CHAR_CODE('sldr')
kControlKindCheckGroupBox	= FOUR_CHAR_CODE('cgrp')

```

kControlKindPopupGroupBox      = FOUR_CHAR_CODE('pgrp')
kControlKindClock               = FOUR_CHAR_CODE('clck')
kControlKindProgressBar        = FOUR_CHAR_CODE('prgb')
kControlKindRelevanceBar       = FOUR_CHAR_CODE('relb')
kControlKindLittleArrows       = FOUR_CHAR_CODE('larr')
kControlKindDisclosureTriangle = FOUR_CHAR_CODE('dist')
kControlKindPicture            = FOUR_CHAR_CODE('pict')
kControlKindIcon               = FOUR_CHAR_CODE('icon')
kControlKindWindowHeader       = FOUR_CHAR_CODE('whed')
kControlKindPlacard            = FOUR_CHAR_CODE('plac')
kControlKindStaticText         = FOUR_CHAR_CODE('stxt')
kControlKindSeparator          = FOUR_CHAR_CODE('sepa')
kControlKindPopupArrow         = FOUR_CHAR_CODE('parr')
kControlKindRadioGroup         = FOUR_CHAR_CODE('rgrp')
kControlKindChasingArrows      = FOUR_CHAR_CODE('carr')
kControlKindScrollingTextBox   = FOUR_CHAR_CODE('stbx')
kControlKindDisclosureButton    = FOUR_CHAR_CODE('disb')
kControlKindRoundButton        = FOUR_CHAR_CODE('rndb')

```

## Data Types

```

typedef Sint16 ControlFocusPart;
typedef Sint16 ControlKeyFilterResult;
typedef Sint16 ControlButtonGraphicAlignment;
typedef Sint16 ControlButtonTextAlignment;
typedef Sint16 ControlButtonTextPlacement;
typedef Sint16 ControlContentType;
typedef Sint16 ControlVariant;
typedef UInt16 ControlSliderOrientation;
typedef UInt16 ControlClockType;
typedef UInt16 ControlDisclosureTriangleOrientation;
typedef Sint16 ControlRoundButtonSize;

```

## Button Content Info Structure

```

struct ControlButtonContentInfo
{
    ControlContentType contentType;
    union {
        Sint16      resID;
        CIconHandle cIconHandle;
        Handle       iconSuite;
        IconRef      iconRef;
        PicHandle    picture;
        Handle       ICONHandle;
    } u;
};

typedef struct ControlButtonContentInfo ControlButtonContentInfo;
typedef ControlButtonContentInfo *ControlButtonContentInfoPtr;
typedef ControlButtonContentInfo ControlImageContentInfo;
typedef ControlButtonContentInfo *ControlImageContentInfoPtr;

```

## Tab Information Structures

```
struct ControlTabInfoRec
{
    SInt16 version;
    SInt16 iconSuiteID;
    Str255 name;
};
typedef struct ControlTabInfoRec ControlTabInfoRec;
```

```
struct ControlTabInfoRecV1
{
    SInt16 version;
    SInt16 iconSuiteID;
    CFStringRef name;
};
typedef struct ControlTabInfoRecV1 ControlTabInfoRecV1;
```

## Tab Entry Structures

```
struct ControlTabEntry
{
    ControlButtonContentInfo *icon;
    CFStringRef name;
    Boolean enabled;
};
typedef struct ControlTabEntry ControlTabEntry;
```

## Edit Text Selection Structure

```
struct ControlEditTextSelectionRec
{
    SInt16 selStart;
    SInt16 selEnd;
};
typedef struct ControlEditTextSelectionRec ControlEditTextSelectionRec;
typedef ControlEditTextSelectionRec * ControlEditTextSelectionPtr;
```

## Functions

### Give Idle Time To Controls

```
void IdleControls(WindowPtr inWindow);
```

### Send Keyboard Event to Control with Keyboard Focus

```
SInt16 HandleControlKey(ControlRef inControl, SInt16 inKeyCode, SInt16 inCharCode,
    SInt16 inModifiers);
```

### Set the Background for a Control

```
OSErr SetUpControlBackground (ControlRef inControl, SInt16 inDepth, Boolean inIsColorDevice);
```

### Keyboard Focus

```
OSErr GetKeyboardFocus(WindowPtr inWindow, ControlRef *outControl);
OSErr SetKeyboardFocus(WindowPtr inWindow, ControlRef inControl, ControlFocusPart inPart);
OSErr AdvanceKeyboardFocus(WindowPtr inWindow);
OSErr ReverseKeyboardFocus(WindowPtr inWindow);
OSErr ClearKeyboardFocus(WindowPtr inWindow);
```

## Control Features

```
OS_ERR GetControlFeatures(ControlRef inControl, UInt32 *outFeatures);
```

## Validating Controls

```
Boolean IsValidControlHandle(ControlRef theControl);
```

## Creating Controls Programmatically

```
OSStatus CreateBevelButtonControl(WindowRef window, const Rect *boundsRect,
    CFStringRef title, ControlBevelThickness thickness,
    ControlBevelButtonBehavior behavior, ControlButtonContentInfoPtr info, SInt16 menuID,
    ControlBevelButtonMenuBehavior menuBehavior,
    ControlBevelButtonMenuPlacement menuPlacement, ControlRef *outControl);
OSStatus CreateImageWellControl(WindowRef window, const Rect *boundsRect,
    const ControlButtonContentInfo *info, ControlRef *outControl);
OSStatus CreateTabsControl(WindowRef window, const Rect *boundsRect, ControlTabSize size,
    ControlTabDirection direction, UInt16 numTabs, const ControlTabEntry *tabArray,
    ControlRef *outControl);
OSStatus CreateEditTextControl(WindowRef window, const Rect *boundsRect, CFStringRef text,
    Boolean isPassword, Boolean useInlineInput, const ControlFontStyleRec *style,
    ControlRef *outControl);
OSStatus CreateSliderControl(WindowRef window, const Rect *boundsRect, SInt32 value,
    SInt32 minimum, SInt32 maximum, ControlSliderOrientation orientation,
    UInt16 numTickMarks, Boolean liveTracking, ControlActionUPP liveTrackingProc,
    ControlRef *outControl);
OSStatus CreateGroupBoxControl(WindowRef window, const Rect *boundsRect, CFStringRef title,
    Boolean primary, ControlRef *outControl);
OSStatus CreateCheckGroupBoxControl(WindowRef window, const Rect *boundsRect,
    CFStringRef title, Boolean primary, Boolean autoToggle, ControlRef *outControl);
OSStatus CreatePopupGroupBoxControl(WindowRef window, const Rect *boundsRect,
    CFStringRef title, Boolean primary, SInt16 menuID, Boolean variableWidth,
    SInt16 titleWidth, SInt16 titleJustification, Style titleStyle, ControlRef *outControl);
OSStatus CreateClockControl(WindowRef window, const Rect *boundsRect,
    ControlClockType clockType,
    ControlClockFlags clockFlags, ControlRef *outControl);
OSStatus CreateProgressBarControl(WindowRef window, const Rect *boundsRect, SInt32 value,
    SInt32 minimum, SInt32 maximum, Boolean indeterminate, ControlRef *outControl);
OSStatus CreateLittleArrowsControl(WindowRef window, const Rect *boundsRect, SInt32 value,
    SInt32 minimum, SInt32 maximum, SInt32 increment, ControlRef *outControl);
OSStatus CreateDisclosureTriangleControl(WindowRef window, const Rect *boundsRect,
    ControlDisclosureTriangleOrientation orientation, CFStringRef title,
    Boolean drawTitle, Boolean autoToggles, ControlRef *outControl);
OSStatus CreatePictureControl(WindowRef window, const Rect *boundsRect,
    const ControlButtonContentInfo *content, Boolean dontTrack, ControlRef *outControl);
OSStatus CreateIconControl(WindowRef window, const Rect *boundsRect,
    const ControlButtonContentInfo *icon, Boolean dontTrack, ControlRef *outControl);
OSStatus CreateWindowHeaderControl(WindowRef window, const Rect *boundsRect,
    Boolean isListHeader, ControlRef *outControl);
OSStatus CreatePlacardControl(WindowRef window, const Rect *boundsRect, ControlRef *outControl);
OSStatus CreateStaticTextControl(WindowRef window, const Rect *boundsRect,
    CFStringRef text, const ControlFontStyleRec *style, ControlRef *outControl);
OSStatus CreateSeparatorControl(WindowRef window, const Rect *boundsRect,
    ControlRef *outControl);
```

```

OSStatus CreatePopupArrowControl(WindowRef window,const Rect *boundsRect,
    ControlPopupArrowOrientation orientation,ControlPopupArrowSize size,
    ControlRef *outControl);
OSStatus CreateRadioGroupControl(WindowRef window,const Rect *boundsRect,
    ControlRef *outControl);
OSStatus CreateChasingArrowsControl(WindowRef window,const Rect *boundsRect,
    ControlRef *outControl);
OSStatus CreateUserPaneControl(WindowRef window,const Rect *boundsRect,UInt32 features,
    ControlRef *outControl);
OSStatus CreateScrollingTextBoxControl(WindowRef window,const Rect *boundsRect,
    SInt16 contentResID, Boolean autoScroll,UInt32 delayBeforeAutoScroll,
    UInt32 delayBetweenAutoScroll, UInt16 autoScrollAmount,ControlRef *outControl);

```

## Creating Controls Programmatically (Controls Available on Mac OS X Only)

```

OSStatus CreateRelevanceBarControl(WindowRef window,const Rect *boundsRect,SInt32 value,
    SInt32 minimum,SInt32 maximum,ControlRef *outControl);
OSStatus CreateDisclosureButtonControl(WindowRef inWindow,const Rect *inBoundsRect,
    SInt32 inValue,Boolean inAutoToggles,ControlRef * outControl);
OSStatus CreateEditUnicodeTextControl(WindowRef window,const Rect *boundsRect,
    CFStringRef text,Boolean isPassword,const ControlFontStyleRec *style,
    ControlRef *outControl);
OSStatus CreateRoundButtonControl(WindowRef nWindow,const Rect *inBoundsRect,
    ControlRoundButtonSize inSize,ControlButtonContentInfo *inContent,
    ControlRef *outControl);

```

## Helper Functions

```

OSErr GetBevelButtonMenuValue ControlRef inButton,SInt16 * outValue);
OSErr SetBevelButtonMenuValue ControlRef inButton,SInt16 inValue);
OSErr GetBevelButtonMenuHandle ControlRef inButton,MenuHandle * outHandle);
OSErr GetBevelButtonContentInfo ControlRef inButton,
    ControlButtonContentInfoPtr outContent);
OSErr SetBevelButtonContentInfo ControlRef inButton,ControlButtonContentInfoPtr inContent);
OSErr SetBevelButtonTransform ControlRef inButton,IconTransformType transform);
OSErr SetBevelButtonGraphicAlignment ControlRef inButton,
    ControlButtonGraphicAlignment inAlign,SInt16 inHOffset,SInt16 inVOffset);
OSErr SetBevelButtonTextAlignment ControlRef inButton,ControlButtonTextAlignment inAlign,
    SInt16 inHOffset);
OSErr SetBevelButtonTextPlacement ControlRef inButton,ControlButtonTextPlacement inWhere);
OSErr GetImageWellContentInfo(ControlRef inButton,ControlButtonContentInfoPtr outContent);
OSErr SetImageWellContentInfo(ControlRef inButton,ControlButtonContentInfoPtr inContent);
OSErr SetImageWellTransform(ControlRef inButton,IconTransformType inTransform);
OSErr GetTabContentRect(ControlRef inTabControl,Rect * outContentRect);
OSErr SetTabEnabled(ControlRef inTabControl,SInt16 inTabToHilite,Boolean inEnabled);
OSErr SetDisclosureTriangleLastValue(ControlRef inTabControl,SInt16 inValue);

```

## Application-Defined (Callback) Functions

```

ControlKeyFilterResult myKeyFilterFunction(ControlRef controlRef,SInt16* keyCode,
    SInt16 *charCode,EventModifiers *modifiers);
void myEditTextValidationFunction(ControlRef controlHdl);

```



## Creating and Disposing of Universal Procedure Pointers—User Pane Functions

```
ControlUserPaneDrawUPP      NewControlUserPaneDrawUPP(ControlUserPaneDrawProcPtr userRoutine);
ControlUserPaneHitTestUPP   NewControlUserPaneHitTestUPP(ControlUserPaneHitTestProcPtr
                           userRoutine);
ControlUserPaneTrackingUPP  NewControlUserPaneTrackingUPP(ControlUserPaneTrackingProcPtr
                           userRoutine);
ControlUserPaneIdleUPP      NewControlUserPaneIdleUPP(ControlUserPaneIdleProcPtr
                           userRoutine);
ControlUserPaneKeyDownUPP   NewControlUserPaneKeyDownUPP(ControlUserPaneKeyDownProcPtr
                           userRoutine);
ControlUserPaneActivateUPP  NewControlUserPaneActivateUPP(ControlUserPaneActivateProcPtr
                           userRoutine);
ControlUserPaneFocusUPP     NewControlUserPaneFocusUPP(ControlUserPaneFocusProcPtr
                           userRoutine);
ControlUserPaneBackgroundUPP NewControlUserPaneBackgroundUPP(ControlUserPaneBackgroundProcPtr
                           userRoutine);

void      DisposeControlUserPaneDrawUPP(ControlUserPaneDrawUPP userUPP);
void      DisposeControlUserPaneHitTestUPP(ControlUserPaneHitTestUPP userUPP);
void      DisposeControlUserPaneTrackingUPP(ControlUserPaneTrackingUPP userUPP);
void      DisposeControlUserPaneIdleUPP(ControlUserPaneIdleUPP userUPP);
void      DisposeControlUserPaneKeyDownUPP(ControlUserPaneKeyDownUPP userUPP);
void      DisposeControlUserPaneActivateUPP(ControlUserPaneActivateUPP userUPP);
void      DisposeControlUserPaneFocusUPP(ControlUserPaneFocusUPP userUPP);
void      DisposeControlUserPaneBackgroundUPP(ControlUserPaneBackgroundUPP userUPP);
```

## Demonstration Program Controls3 Listing

```
// *****
// Controls3.h                                     CLASSIC EVENT MODEL
// *****
//
// This program demonstrates the creation and handling of those controls not demonstrated in
// the programs Controls1 and Controls2 (Chapter 7), with the exception of List boxes
// and determinate progress bars.
//
// The program utilises the following resources:
//
// • A 'plst' resource.
//
// • An 'MBAR' resource, and 'MENU' resources for Apple, File, Edit, and Demonstration menus
//   (preload, non-purgeable).
//
// • 'MENU' resources (non-purgeable) for bevel button menus and for a pop-up group box.
//
// • A 'WIND' resource (purgeable) (initially not visible).
//
// • 'DLOG' resources and associated 'DITL', 'dlgx' and 'dftb' resources (purgeable).
//
// • 'CNTL' resources (purgeable).
//
// • A 'tab#' resource (purgeable).
//
// • An icon family resource (purgeable).
//
```

```

// · 'PICT' resources (purgeable).
//
// · 'cicn' resources (purgeable).
//
// · 'STR#' resources (purgeable).
//
// · 'TEXT' and 'styl' resources (purgeable).
//
// · 'hrct' and an 'hwin' resources (preload, purgeable), which provide help balloons
//   describing the various controls.
//
// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****

// ..... includes

#include <Carbon.h>
#include <string.h>

// ..... defines

#define rMenubar          128
#define mAppleApplication 128
#define iAbout            1
#define mFile             129
#define iQuit             12
#define mDemonstration    131
#define iBevelAndImage     1
#define iTabEditClock      2
#define iGroupArrowsProgress 3
#define iSliders           4
#define iTextBoxes         5
#define iSmallControls     6
#define rBevelImageWindow  128
#define cBevelButton1      128
#define cBevelButton2      129
#define cBevelButton3      130
#define cBevelButton4      131
#define cBevelButton5      132
#define cBevelButton6      133
#define cBevelButton7      134
#define cBevelButton8      135
#define cBevelButton9      136
#define cBevelButton10     137
#define cBevelButton11     138
#define cBevelButton12     139
#define cBevelButton13     140
#define cBevelButton14     141
#define cBevelButton15     142
#define cBevelButton16     143
#define cBevelButton17     144
#define cBevelButton18     145

```

#define	cBevelButton19	146
#define	cBevelButton20	147
#define	cBevelButton21	148
#define	cImageWell1	149
#define	cImageWell2	150
#define	cPicture1	151
#define	cPicture2	152
#define	cColorIcon1	153
#define	cColorIcon2	154
#define	cIconSuite1	155
#define	cIconSuite2	156
#define	cWindowHeader	157
#define	rPartCodeStrings	128
#define	rGraphicAlignStrings	129
#define	rTextAlignStrings	130
#define	rTextPlacementStrings	131
#define	rTabEditClockDialog	128
#define	iTabs	2
#define	tabEditText	1
#define	tabClocks	2
#define	iEditTextUserPane	3
#define	iEditText1	5
#define	iEditText2	7
#define	iEditText3	9
#define	iExtractEditText	10
#define	iClocksUserPane	12
#define	iImageWellEditText	11
#define	iClocks1	14
#define	iClocks2	16
#define	iClocks3	18
#define	iExtractClocks	19
#define	iImageWellClocks	20
#define	kLeftArrow	0x1C
#define	kRightArrow	0x1D
#define	kUpArrow	0x1E
#define	kDownArrow	0x1F
#define	kBackspace	0x08
#define	kDelete	0x7F
#define	rGroupArrowsProgDialog	129
#define	iCheckboxGroup	2
#define	iRadioGroupColor	3
#define	iStaticTextColorDepth	7
#define	iPopupGroup	8
#define	iUserPaneNamesInitials	9
#define	iRadioGroupNames	10
#define	iCheckboxShowInitials	13
#define	iUserPaneScoreAverage	15
#define	iRadioGroupScores	16
#define	iCheckboxShowAverages	19
#define	iStaticTextCache	26
#define	iLittleArrows	27
#define	iPushButtonExtract	28
#define	iImageWell	29
#define	iDisclosureTriangle	31
#define	iStaticTextDisclosure	32
#define	iProgressBar	34

```

#define rSlidersDialog          131
#define iSlider1                2
#define iSlider2                3
#define iSlider3                4
#define iSlider4                5
#define iSlider1StaticText      9
#define iSlider2StaticText     11
#define iSlider3StaticText     13
#define iSlider4StaticText     15
#define iSlider5                17
#define iUserPane1              18
#define iSlider6                19
#define cSmallPopup             203
#define rSmallControlsString    136
#define rAboutDialog            132
#define MAX_UINT32              0xFFFFFFFF
#define MIN(a,b)                ((a) < (b) ? (a) : (b))

// ..... typedefs

typedef struct
{
    ControlRef bevelButton1Ref;
    ControlRef bevelButton2Ref;
    ControlRef bevelButton3Ref;
    ControlRef bevelButton4Ref;
    ControlRef bevelButton5Ref;
    ControlRef bevelButton6Ref;
    ControlRef bevelButton7Ref;
    ControlRef bevelButton8Ref;
    ControlRef bevelButton9Ref;
    ControlRef bevelButton10Ref;
    ControlRef bevelButton11Ref;
    ControlRef bevelButton12Ref;
    ControlRef bevelButton13Ref;
    ControlRef bevelButton14Ref;
    ControlRef bevelButton15Ref;
    ControlRef bevelButton16Ref;
    ControlRef bevelButton17Ref;
    ControlRef bevelButton18Ref;
    ControlRef bevelButton19Ref;
    ControlRef bevelButton20Ref;
    ControlRef bevelButton21Ref;
    ControlRef imageWell1Ref;
    ControlRef imageWell2Ref;
    ControlRef picture1Ref;
    ControlRef picture2Ref;
    ControlRef colorIcon1Ref;
    ControlRef colorIcon2Ref;
    ControlRef iconSuite1Ref;
    ControlRef iconSuite2Ref;
    ControlRef windowHeaderRef;
} BevelDocStruc;

typedef BevelDocStruc **BevelDocStrucHandle;

```

// ..... function prototypes

```

void    main                                (void);
void    doPreliminaries                    (void);
OSErr   quitAppEventHandler                 (AppleEvent *,AppleEvent *,SInt32);
void    doGetControls                      (WindowRef);
void    doEvents                          (EventRecord *);
void    doMouseDown                       (EventRecord *);
void    doMenuChoice                      (SInt32);
void    doUpdate                          (EventRecord *);
void    doActivate                        (EventRecord *);
void    doActivateWindow                  (WindowRef,Boolean);
void    doConcatPStrings                  (Str255,Str255);
void    doCopyPString                     (Str255,Str255);

void    doBevelImagePictIcon              (void);
void    doBevelImagePictIconContent       (EventRecord *,WindowRef);
void    doDrawPartCode                    (WindowRef,ControlRef,SInt16,SInt16);
void    doGraphicAlignment                (WindowRef,ControlRef,ControlRef);
void    doTextAlignment                   (WindowRef,ControlRef,ControlRef);
void    doTextOffset                     (WindowRef,ControlRef,ControlRef);
void    doTextPlacement                   (WindowRef,ControlRef,ControlRef);
void    doDrawMessage                     (WindowRef,Boolean);
void    doDrawLegends                     (WindowRef,Boolean);
void    helpTagsBevelImagePictIcon        (WindowRef);

void    doTabEditClock                    (void);
void    doExtractEditText                 (DialogRef);
void    doExtractDateTime                 (DialogRef);
void    helpTagsTabEditClock              (DialogRef);

void    doGroupArrowsProgress             (void);
void    doCheckBoxGroupBox                (DialogRef);
void    doPopupGroupBox                   (DialogRef);
void    doChasingAndProgress              (DialogRef);
void    doExtractCurrentStatus            (DialogRef);
void    helpTagsGroupArrowsProgress       (DialogRef);

void    doSliderUserPane                  (void);
void    doDrawSliderValues                (DialogRef,ControlRef);
void    helpTagsSliders                   (DialogRef);

void    doTextBox                         (void);

void    doSmallControls                   (void);
void    doMouseDownSmallControls          (WindowRef,EventRecord *);

Boolean eventFilter                      (DialogRef,EventRecord *,SInt16 *);
void    editTextValidator                 (ControlRef);
ControlKeyFilterResult numericFilter      (ControlRef,SInt16 *,SInt16 *,EventModifiers *);
void    arrowsActionFunction              (ControlRef,SInt16);
void    sliderActionFunction1             (ControlRef,SInt16);
void    sliderActionFunction2             (ControlRef,SInt16);
void    userPaneDrawFunction              (ControlRef,SInt16);
void    userPaneActivateFunction          (ControlRef,Boolean);

```

```
// *****
// Controls3.c
// *****

// ..... includes

#include "Controls3.h"

// ..... global variables

Boolean gRunningOnX          = false;
Boolean gInBackground        = false;
Boolean gDone;
Str255 gCurrentString;
Boolean gBevelAndImageActive = false;
Boolean gGroupArrowsProgressActive = false;
Boolean gSlidersActive       = false;

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;
    MenuRef        menuRef;
    EventRecord     eventStructure;

    // ..... do preliminaries

    doPreliminaries();

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMenubar);
    if(menubarHdl == NULL)
        ExitToShell();
    SetMenuBar(menubarHdl);
    DrawMenuBar();

    Gestalt(gestaltMenuMgrAttr,&response);
    if(response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
        {
            DeleteMenuItem(menuRef,iQuit);
            DeleteMenuItem(menuRef,iQuit - 1);
            DisableMenuItem(menuRef,0);
        }

        menuRef = GetMenuRef(mDemonstration);
        if(menuRef != NULL)
            EnableMenuItem(menuRef,iSmallControls);

        gRunningOnX = true;
    }
}
```

```

// ..... enter eventLoop

gDone = false;

while(!gDone)
{
    if(WaitNextEvent(everyEvent,&eventStructure,MAX_UINT32,NULL))
        doEvents(&eventStructure);
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    OSErr osError;

    MoreMasterPointers(512);
    InitCursor();
    FlushEvents(everyEvent,0);

    osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
                                   NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
                                   0L,false);

    if(osError != noErr)
        ExitToShell();
}

// ***** doQuitAppEvent

OSErr quitAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,SInt32 handlerRefcon)
{
    OSErr osError;
    DescType returnedType;
    Size actualSize;

    osError = AEGetAttributePtr(appEvent,keyMissedKeywordAttr,typeWildCard,&returnedType,NULL,0,
                                &actualSize);

    if(osError == errAEDescNotFound)
    {
        gDone = true;
        osError = noErr;
    }
    else if(osError == noErr)
        osError = errAEParamMissed;

    return osError;
}

// ***** doEvents

```



```

void doEvents(EventRecord *eventStrucPtr)
{
    SInt32 menuChoice;
    SInt16 menuID, menuItem;

    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEProcessAppleEvent(eventStrucPtr);
            break;

        case keyDown:
            if((eventStrucPtr->modifiers & cmdKey) != 0)
            {
                menuChoice = MenuEvent(eventStrucPtr);
                menuID = HiWord(menuChoice);
                menuItem = LoWord(menuChoice);
                if(menuID == mFile && menuItem == iQuit)
                    gDone = true;
            }
            break;

        case mouseDown:
            doMouseDown(eventStrucPtr);
            break;

        case updateEvt:
            doUpdate(eventStrucPtr);
            break;

        case activateEvt:
            doActivate(eventStrucPtr);
            break;

        case osEvt:
            switch((eventStrucPtr->message >> 24) & 0x000000FF)
            {
                case suspendResumeMessage:
                    if((eventStrucPtr->message & resumeFlag) == 1)
                    {
                        SetThemeCursor(kThemeArrowCursor);
                        gInBackground = false;
                    }
                    else
                        gInBackground = true;
            }
            break;
    }
}

```

```

// ***** doMouseDown

void doMouseDown(EventRecord *eventStrucPtr)
{
    WindowPartCode partCode;
    WindowRef      windowRef;
    MenuRef        menuRef;
    WindowClass    windowClass;

    partCode = FindWindow(eventStrucPtr->where,&windowRef);

    switch(partCode)
    {
        case inMenuBar:
            menuRef = GetMenuRef(mDemonstration);
            if(gBevelAndImageActive)
                DisableMenuItem(menuRef,iBevelAndImage);
            else
                EnableMenuItem(menuRef,iBevelAndImage);
            doMenuChoice(MenuSelect(eventStrucPtr->where));
            break;

        case inContent:
            GetWindowClass(windowRef,&windowClass);
            if(windowClass == kFloatingWindowClass)
                doMouseDownSmallControls(windowRef,eventStrucPtr);
            else if(windowRef != FrontNonFloatingWindow())
                SelectWindow(windowRef);
            else
            {
                if(gBevelAndImageActive)
                    doBevelImagePictIconContent(eventStrucPtr,windowRef);
            }
            break;

        case inDrag:
            DragWindow(windowRef,eventStrucPtr->where,NULL);
            break;

        case inGoAway:
            if(TrackGoAway(windowRef,eventStrucPtr->where) == true)
            {
                DisposeWindow(windowRef);
                gBevelAndImageActive = false;
            }
            break;
    }
}

```

```
// ***** doMenuChoice

void doMenuChoice(SInt32 menuChoice)
{
    MenuID      menuID;
    MenuItemIndex menuItem;
    MenuRef      menuRef;

    menuID = HiWord(menuChoice);
    menuItem = LoWord(menuChoice);

    if(menuID == 0)
        return;

    switch(menuID)
    {
        case mAppleApplication:
            if(menuItem == iAbout)
                SysBeep(10);
            break;

        case mFile:
            if(menuItem == iQuit)
                gDone = true;
            break;

        case mDemonstration:
            switch(menuItem)
            {
                case iBevelAndImage:
                    gBevelAndImageActive = true;
                    doBevelImagePictIcon();
                    break;

                case iTabEditClock:
                    doTabEditClock();
                    break;

                case iGroupArrowsProgress:
                    gGroupArrowsProgressActive = true;
                    doGroupArrowsProgress();
                    break;

                case iSliders:
                    gSlidersActive = true;
                    doSliderUserPane();
                    break;

                case iTextBoxes:
                    doTextBox();
                    break;
            }
        }
    }
}
```

```

        case iSmallControls:
            doSmallControls();
            menuRef = GetMenuRef(mDemonstration);
            DisableMenuItem(menuRef,iSmallControls);
            break;
    }
    break;
}

HiliteMenu(0);
}

// ***** doUpdate

void doUpdate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    RgnHandle visibleRegionHdl = NewRgn();
    Boolean drawMode = false;

    windowRef = (WindowRef) eventStrucPtr->message;

    BeginUpdate(windowRef);

    SetPortWindowPort(windowRef);

    GetPortVisibleRegion(GetWindowPort(windowRef),visibleRegionHdl);
    UpdateControls(windowRef,visibleRegionHdl);

    if(gBevelAndImageActive)
    {
        if(windowRef == FrontNonFloatingWindow())
        {
            doDrawMessage(windowRef,!gInBackground);
            doDrawLegends(windowRef,!gInBackground);
        }
        else
        {
            doDrawMessage(windowRef,gInBackground);
            doDrawLegends(windowRef,gInBackground);
        }
    }

    EndUpdate(windowRef);
}

// ***** doActivate

void doActivate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    Boolean becomingActive;

```

```

windowRef = (WindowRef) eventStrucPtr->message;
becomingActive = ((eventStrucPtr->modifiers & activeFlag) == activeFlag);

doActivateWindow(windowRef,becomingActive);
}

// ***** doActivateWindow

void doActivateWindow(WindowRef windowRef,Boolean becomingActive)
{
    ControlRef controlRef;

    GetRootControl(windowRef,&controlRef);

    if(becomingActive)
    {
        if(gBevelAndImageActive)
        {
            ActivateControl(controlRef);
            doDrawMessage(windowRef,becomingActive);
            doDrawLegends(windowRef,becomingActive);
        }
    }
    else
    {
        if(gBevelAndImageActive)
        {
            DeactivateControl(controlRef);
            doDrawMessage(windowRef,becomingActive);
            doDrawLegends(windowRef,becomingActive);
        }
    }
}

// ***** doConcatPStrings

void doConcatPStrings(Str255 targetString,Str255 appendString)
{
    SInt16 appendLength;

    appendLength = MIN(appendString[0],255 - targetString[0]);

    if(appendLength > 0)
    {
        BlockMoveData(appendString+1,targetString+targetString[0]+1,(SInt32) appendLength);
        targetString[0] += appendLength;
    }
}

// ***** doCopyPString

void doCopyPString(Str255 sourceString,Str255 destinationString)
{
    SInt16 stringLength;

```

```

    stringLength = sourceString[0];
    BlockMove(sourceString + 1,destinationString + 1,stringLength);
    destinationString[0] = stringLength;
}

// *****
// BevelImagePictIcon.c
// *****

// ..... includes

#include "Controls3.h"

// ..... global variables

WindowRef gWindowRef;

extern Boolean gRunningOnX;
extern Str255 gCurrentString;
extern Boolean gInBackground;

// ***** doBevelImagePictIcon

void doBevelImagePictIcon(void)
{
    BevelDocStrucHandle bevelDocStrucHdl;

    // ..... initial advisory text for window header

    doCopyPString("\pBalloon (OS 8/9) and Help tag (OS X) help is available",gCurrentString);

    // ..... open a window, set font size, set theme-compliant color/pattern for window

    if(!(gWindowRef = GetNewCWindow(rBevelImageWindow,NULL,(WindowRef)-1)))
        ExitToShell();

    SetPortWindowPort(gWindowRef);
    UseThemeFont(kThemeSmallSystemFont,smSystemScript);

    SetThemeWindowBackground(gWindowRef,kThemeBrushDialogBackgroundActive,true);

    // ..... get block for document structure, assign handle to window record refCon field

    if(!(bevelDocStrucHdl = (BevelDocStrucHandle) NewHandle(sizeof(BevelDocStruc))))
        ExitToShell();

    SetWRefCon(gWindowRef,(SInt32) bevelDocStrucHdl);

    // ..... get controls, help tags if OS X, and show window

    doGetControls(gWindowRef);

    if(gRunningOnX)
        helpTagsBevelImagePictIcon(gWindowRef);

```

```

    ShowWindow(gWindowRef);
}

// ***** doGetControls

void doGetControls(WindowRef windowRef)
{
    ControlRef          controlRef;
    BevelDocStrucHandle bevelDocStrucHdl;
    ThemeButtonKind     buttonKind = kThemeRoundedBevelButton;
    ControlButtonTextPlacement textPlacementBelow = kControlBevelButtonPlaceBelowGraphic;
    ControlButtonTextPlacement textPlacementAbove = kControlBevelButtonPlaceAboveGraphic;
    Boolean              centerPopupGlyph = true;
    ControlFontStyleRec  controlFontStyleStruc;

    // ..... create root control for window, get handle to window's document structure

    if(!gRunningOnX)
        CreateRootControl(windowRef,&controlRef);

    bevelDocStrucHdl = (BevelDocStrucHandle) (GetWRefCon(windowRef));

    // ..... get the controls

    if(!((*bevelDocStrucHdl)->bevelButton1Ref = GetNewControl(cBevelButton1>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton2Ref = GetNewControl(cBevelButton2>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton3Ref = GetNewControl(cBevelButton3>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton4Ref = GetNewControl(cBevelButton4>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton5Ref = GetNewControl(cBevelButton5>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton6Ref = GetNewControl(cBevelButton6>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton7Ref = GetNewControl(cBevelButton7>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton8Ref = GetNewControl(cBevelButton8>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton9Ref = GetNewControl(cBevelButton9>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton10Ref = GetNewControl(cBevelButton10>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton11Ref = GetNewControl(cBevelButton11>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton12Ref = GetNewControl(cBevelButton12>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton13Ref = GetNewControl(cBevelButton13>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton14Ref = GetNewControl(cBevelButton14>windowRef)))
        ExitToShell();
    if(!((*bevelDocStrucHdl)->bevelButton15Ref = GetNewControl(cBevelButton15>windowRef)))
        ExitToShell();
}

```



```

if(!(*bevelDocStrucHdl)->bevelButton16Ref = GetNewControl(cBevelButton16,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->bevelButton17Ref = GetNewControl(cBevelButton17,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->bevelButton18Ref = GetNewControl(cBevelButton18,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->bevelButton19Ref = GetNewControl(cBevelButton19,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->bevelButton20Ref = GetNewControl(cBevelButton20,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->bevelButton21Ref = GetNewControl(cBevelButton21,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->imageWell1Ref = GetNewControl(cImageWell1,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->imageWell2Ref = GetNewControl(cImageWell2,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->picture1Ref = GetNewControl(cPicture1,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->picture2Ref = GetNewControl(cPicture2,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->colorIcon1Ref = GetNewControl(cColorIcon1,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->colorIcon2Ref = GetNewControl(cColorIcon2,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->iconSuite1Ref= GetNewControl(cIconSuite1,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->iconSuite2Ref= GetNewControl(cIconSuite2,windowRef)))
    ExitToShell();
if(!(*bevelDocStrucHdl)->>windowHeaderRef = GetNewControl(cWindowHeader,windowRef)))
    ExitToShell();

// ..... if running on OS X, make first four bevel buttons rounded

if(gRunningOnX)
{
    SetControlData((*bevelDocStrucHdl)->bevelButton1Ref,kControlEntireControl,
        kControlBevelButtonKindTag,sizeof(buttonKind),&buttonKind);
    SetControlData((*bevelDocStrucHdl)->bevelButton2Ref,kControlEntireControl,
        kControlBevelButtonKindTag,sizeof(buttonKind),&buttonKind);
    SetControlData((*bevelDocStrucHdl)->bevelButton3Ref,kControlEntireControl,
        kControlBevelButtonKindTag,sizeof(buttonKind),&buttonKind);
    SetControlData((*bevelDocStrucHdl)->bevelButton4Ref,kControlEntireControl,
        kControlBevelButtonKindTag,sizeof(buttonKind),&buttonKind);
}

// ..... set text placement for 2nd and 21st bevel button

SetControlData((*bevelDocStrucHdl)->bevelButton2Ref,kControlEntireControl,
    kControlBevelButtonTextPlaceTag,sizeof(textPlacementBelow),
    &textPlacementBelow);
SetControlData((*bevelDocStrucHdl)->bevelButton21Ref,kControlEntireControl,
    kControlBevelButtonTextPlaceTag,sizeof(textPlacementAbove),
    &textPlacementAbove);

```

```

// ..... set position of pop-up arrow in 6th bevel button

SetControlData((*bevelDocStrucHdl)->bevelButton6Ref,kControlEntireControl,
               kControlBevelButtonCenterPopupGlyphTag,sizeof(centerPopupGlyph),
               &centerPopupGlyph);

// ..... set font for 20th bevel button to small bold system font

controlFontStyleStruc.flags = kControlUseFontMask;
controlFontStyleStruc.font = kControlFontSmallBoldSystemFont;
SetControlFontStyle((*bevelDocStrucHdl)->bevelButton20Ref,&controlFontStyleStruc);

// ..... set 3rd bevel button to the mixed state

SetControlValue((*bevelDocStrucHdl)->bevelButton3Ref,2);
}

// ***** doBevelImagePictIconContent

void doBevelImagePictIconContent(EventRecord *eventStrucPtr,WindowRef windowRef)
{
    BevelDocStrucHandle bevelDocStrucHdl;
    ControlRef          controlRef;
    SInt16              partCode, menuItem;

    bevelDocStrucHdl = (BevelDocStrucHandle) (GetWRefCon(windowRef));

    SetPortWindowPort(windowRef);
    GlobalToLocal(&eventStrucPtr->where);
    partCode = FindControl(eventStrucPtr->where,windowRef,&controlRef);

    doDrawPartCode(windowRef,(*bevelDocStrucHdl)->windowHeaderRef,partCode,1234);

    if(partCode)
    {
        partCode = TrackControl(controlRef,eventStrucPtr->where,NULL);

        if(controlRef == (*bevelDocStrucHdl)->bevelButton1Ref ||
           controlRef == (*bevelDocStrucHdl)->bevelButton2Ref ||
           controlRef == (*bevelDocStrucHdl)->bevelButton3Ref ||
           controlRef == (*bevelDocStrucHdl)->bevelButton4Ref ||
           controlRef == (*bevelDocStrucHdl)->bevelButton9Ref ||
           controlRef == (*bevelDocStrucHdl)->bevelButton13Ref ||
           controlRef == (*bevelDocStrucHdl)->bevelButton14Ref ||
           controlRef == (*bevelDocStrucHdl)->bevelButton15Ref ||
           controlRef == (*bevelDocStrucHdl)->bevelButton16Ref ||
           controlRef == (*bevelDocStrucHdl)->bevelButton17Ref)
        {
            doDrawPartCode(windowRef,(*bevelDocStrucHdl)->windowHeaderRef,partCode,4321);
        }
        else if(controlRef == (*bevelDocStrucHdl)->bevelButton5Ref ||
              controlRef == (*bevelDocStrucHdl)->bevelButton6Ref ||
              controlRef == (*bevelDocStrucHdl)->bevelButton7Ref ||
              controlRef == (*bevelDocStrucHdl)->bevelButton8Ref)

```

```

{
    if(partCode == kControlMenuPart)
    {
        GetBevelButtonMenuValue(controlRef,&menuItem);
        doDrawPartCode(windowRef,(*bevelDocStrucHdl)->windowHeaderRef,partCode,menuItem);
    }
    else
        doDrawPartCode(windowRef,(*bevelDocStrucHdl)->windowHeaderRef,partCode,4321);
}
else if(controlRef == (*bevelDocStrucHdl)->bevelButton10Ref ||
        controlRef == (*bevelDocStrucHdl)->bevelButton11Ref ||
        controlRef == (*bevelDocStrucHdl)->bevelButton12Ref)
{
    if(partCode != kControlEntireControl)
    {
        SetControlValue((*bevelDocStrucHdl)->bevelButton10Ref,0);
        SetControlValue((*bevelDocStrucHdl)->bevelButton11Ref,0);
        SetControlValue((*bevelDocStrucHdl)->bevelButton12Ref,0);
        SetControlValue(controlRef,1);
    }
    doDrawPartCode(windowRef,(*bevelDocStrucHdl)->windowHeaderRef,partCode,4321);
}
else if(controlRef == (*bevelDocStrucHdl)->bevelButton18Ref)
{
    doDrawPartCode(windowRef,(*bevelDocStrucHdl)->windowHeaderRef,partCode,4321);
    doGraphicAlignment(windowRef,controlRef,(*bevelDocStrucHdl)->windowHeaderRef);
}
else if(controlRef == (*bevelDocStrucHdl)->bevelButton19Ref)
{
    doDrawPartCode(windowRef,(*bevelDocStrucHdl)->windowHeaderRef,partCode,4321);
    doTextAlignment(windowRef,controlRef,(*bevelDocStrucHdl)->windowHeaderRef);
}
else if(controlRef == (*bevelDocStrucHdl)->bevelButton20Ref)
{
    doDrawPartCode(windowRef,(*bevelDocStrucHdl)->windowHeaderRef,partCode,4321);
    doTextOffset(windowRef,controlRef,(*bevelDocStrucHdl)->windowHeaderRef);
}
else if(controlRef == (*bevelDocStrucHdl)->bevelButton21Ref)
{
    doDrawPartCode(windowRef,(*bevelDocStrucHdl)->windowHeaderRef,partCode,4321);
    doTextPlacement(windowRef,controlRef,(*bevelDocStrucHdl)->windowHeaderRef);
}
else
    doDrawPartCode(windowRef,(*bevelDocStrucHdl)->windowHeaderRef,partCode,4321);
}
}

// ***** doDrawPartCode

void doDrawPartCode(WindowRef windowRef,ControlRef windowHeaderRef,SInt16 partCode,
                    SInt16 menuItem)
{
    SInt16 stringIndex;
    Str255 theString;

```

```

if(partCode == kControlEntireControl)
    stringIndex = 1;
else if(partCode == kControlMenuPart)
    stringIndex = 2;
else if(partCode == kControlTrianglePart)
    stringIndex = 3;
else if(partCode == kControlEditTextPart)
    stringIndex = 4;
else if(partCode == kControlPicturePart)
    stringIndex = 5;
else if(partCode == kControlIconPart)
    stringIndex = 6;
else if(partCode == kControlClockPart)
    stringIndex = 7;
else if(partCode == kControlListBoxPart)
    stringIndex = 8;
else if(partCode == kControlListBoxDoubleClickPart)
    stringIndex = 9;
else if(partCode == kControlImageWellPart)
    stringIndex = 10;
else if(partCode == kControlRadioGroupPart)
    stringIndex = 11;
else if(partCode == kControlButtonPart)
    stringIndex = 12;
else if(partCode == kControlIndicatorPart)
    stringIndex = 13;

if(menuItem > 0 && menuItem < 1234)
{
    doCopyPString("\pTrackControl returned ",gCurrentString);
    GetIndString(theString,rPartCodeStrings,stringIndex);
    doConcatPStrings(gCurrentString,theString);
    doConcatPStrings(gCurrentString,"\p    GetBevelButtonMenuValue returned menu item ");
    NumToString((SInt32) menuItem,theString);
    doConcatPStrings(gCurrentString,theString);
}
else if(menuItem == 1234 || menuItem == 4321)
{
    if(menuItem == 1234)
        doCopyPString("\pMouse-down in ",gCurrentString);
    else if(menuItem == 4321)
        doCopyPString("\pTrackControl returned ",gCurrentString);
    GetIndString(theString,rPartCodeStrings,stringIndex);
    doConcatPStrings(gCurrentString,theString);
}

Draw1Control(windowHeaderRef);
doDrawMessage(windowRef,true);
}

// ***** doGraphicAlignment

```

```

void doGraphicAlignment(WindowRef windowRef,ControlRef controlRef,ControlRef windowHeaderRef)
{
    SInt16                a, b;
    UInt32                finalTicks;
    ControlButtonGraphicAlignment alignmentConstant = 0;

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    for(a=1;a<10;a++)
    {
        Delay(60,&finalTicks);
        alignmentConstant++;
        if(alignmentConstant == 9)
            alignmentConstant = 0;

        Draw1Control(windowHeaderRef);
        GetIndString(gCurrentString,rGraphicAlignStrings,a);
        doDrawMessage(windowRef,true);

        for(b=0;b<=52;b++)
        {
            SetBevelButtonGraphicAlignment(controlRef,alignmentConstant,b,b);
            Delay(2,&finalTicks);
            Draw1Control(controlRef);
            QDFlushPortBuffer(GetWindowPort(FrontNonFloatingWindow()),NULL);
        }
    }

    if(!gRunningOnX)
        SetThemeCursor(kThemeArrowCursor);
}

// ***** doTextAlignment

void doTextAlignment(WindowRef windowRef,ControlRef controlRef,ControlRef windowHeaderRef)
{
    SInt16                a, b;
    UInt32                finalTicks;
    ControlButtonTextAlignment alignmentConstant = -3;

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    for(a=1;a<4;a++)
    {
        Delay(60,&finalTicks);
        alignmentConstant++;
        if(alignmentConstant == 0)
            alignmentConstant++;

        Draw1Control(windowHeaderRef);
        GetIndString(gCurrentString,rTextAlignStrings,a);
        doDrawMessage(windowRef,true);
    }
}

```

```

    for(b=0;b<=40;b++)
    {
        SetBevelButtonTextAlignment(controlRef,alignmentConstant,b);
        Delay(2,&finalTicks);
        Draw1Control(controlRef);
        QDFlushPortBuffer(GetWindowPort(FrontNonFloatingWindow()),NULL);
    }
}

if(!gRunningOnX)
    SetThemeCursor(kThemeArrowCursor);
}

// ***** doTextOffset

void doTextOffset(WindowRef windowRef,ControlRef controlRef,ControlRef windowHeaderRef)
{
    ControlButtonTextAlignment alignmentConstant;
    Sint16 offset;
    UInt32 finalTicks;

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    Draw1Control(windowHeaderRef);
    doCopyPString("\pOffset from left",gCurrentString);
    doDrawMessage(windowRef,true);

    alignmentConstant = kControlBevelButtonAlignTextFlushLeft;
    SetControlData(controlRef,kControlEntireControl,kControlBevelButtonTextAlignTag,
        sizeof(alignmentConstant),&alignmentConstant);
    Draw1Control(controlRef);

    for(offset=1;offset<27;offset++)
    {
        Delay(15,&finalTicks);
        SetControlData(controlRef,kControlEntireControl,kControlBevelButtonTextOffsetTag,
            sizeof(offset),&offset);
        Draw1Control(controlRef);
        QDFlushPortBuffer(GetWindowPort(FrontNonFloatingWindow()),NULL);
    }

    Delay(60,&finalTicks);

    Draw1Control(windowHeaderRef);
    doCopyPString("\pOffset from right",gCurrentString);
    doDrawMessage(windowRef,true);

    alignmentConstant = kControlBevelButtonAlignTextFlushRight;
    SetControlData(controlRef,kControlEntireControl,kControlBevelButtonTextAlignTag,
        sizeof(alignmentConstant),&alignmentConstant);

```

```

    for(offset=0;offset<13;offset++)
    {
        Delay(15,&finalTicks);
        SetControlData(controlRef,kControlEntireControl,kControlBevelButtonTextOffsetTag,
            sizeof(offset),&offset);
        Draw1Control(controlRef);
        QDFlushPortBuffer(GetWindowPort(FrontNonFloatingWindow()),NULL);
    }

    if(!gRunningOnX)
        SetThemeCursor(kThemeArrowCursor);
}

// ***** doTextPlacement

void doTextPlacement(WindowRef windowRef,ControlRef controlRef,ControlRef windowHeaderRef)
{
    ControlButtonTextPlacement placementConstant;
    UInt32 finalTicks;

    if(!gRunningOnX)
        SetThemeCursor(kThemeWatchCursor);

    for(placementConstant = 1;placementConstant < 5;placementConstant++)
    {
        Delay(60,&finalTicks);
        SetBevelButtonTextPlacement(controlRef,placementConstant);
        Draw1Control(controlRef);
        Draw1Control(windowHeaderRef);
        GetIndString(gCurrentString,rTextPlacementStrings,placementConstant);
        doDrawMessage(windowRef,true);
        QDFlushPortBuffer(GetWindowPort(FrontNonFloatingWindow()),NULL);
    }

    if(!gRunningOnX)
        SetThemeCursor(kThemeArrowCursor);
}

// ***** doDrawMessage

void doDrawMessage(WindowRef windowRef,Boolean inState)
{
    Rect portRect;
    CFStringRef stringRef;
    Rect textBoxRect;

    if(windowRef == gWindowRef)
    {
        SetPortWindowPort(windowRef);

        GetWindowPortBounds(windowRef,&portRect);
    }
}

```



```

stringRef = CFStringCreateWithPascalString(NULL,gCurrentString,kCFStringEncodingMacRoman);
SetRect(&textBoxRect,portRect.left,7,portRect.right,22);

if(inState == kThemeStateActive)
    TextMode(srcOr);
else
    TextMode(grayishTextOr);

DrawThemeTextBox(stringRef,kThemeSmallSystemFont,inState,true,&textBoxRect,teJustCenter,
    NULL);
if(stringRef != NULL)
    CFRelease(stringRef);
}
}

// ***** doDrawLegends

void doDrawLegends(WindowRef windowRef,Boolean inState)
{
    Rect theRect;

    if(windowRef == gWindowRef)
    {
        SetPortWindowPort(windowRef);

        if(gRunningOnX)
        {
            SetRect(&theRect,30,54,585,67);
            EraseRect(&theRect);
            OffsetRect(&theRect,0,91);
            EraseRect(&theRect);
            OffsetRect(&theRect,0,92);
            EraseRect(&theRect);
        }

        if(inState == kThemeStateActive)
            TextMode(srcOr);
        else
            TextMode(grayishTextOr);

        SetRect(&theRect,30,53,220,68);
        if(gRunningOnX)
            DrawThemeTextBox(CFSTR("Bevel button content"),kThemeSmallSystemFont,inState,false,
                &theRect,teJustLeft,NULL);
        else
            DrawThemeTextBox(CFSTR("Bevel sizes and bevel button content"),kThemeSmallSystemFont,
                inState,false,&theRect,teJustLeft,NULL);
        SetRect(&theRect,313,53,513,68);
        DrawThemeTextBox(CFSTR("Menu position and behavior"),kThemeSmallSystemFont,inState,
            false,&theRect,teJustLeft,NULL);
        SetRect(&theRect,30,144,180,159);
        DrawThemeTextBox(CFSTR("Bevel button behavior"),kThemeSmallSystemFont,inState,false,
            &theRect,teJustLeft,NULL);
    }
}

```

```

    SetRect(&theRect,313,144,513,159);
    DrawThemeTextBox(CFSTR("Graphic/text alignment & offset"),kThemeSmallSystemFont,inState,
        false,&theRect,teJustLeft,NULL);
    SetRect(&theRect,490,144,640,159);
    DrawThemeTextBox(CFSTR("Text placement"),kThemeSmallSystemFont,inState,false,&theRect,
        teJustLeft,NULL);
    SetRect(&theRect,30,235,180,250);
    DrawThemeTextBox(CFSTR("Image wells"),kThemeSmallSystemFont,inState,false,&theRect,
        teJustLeft,NULL);
    SetRect(&theRect,168,235,308,250);
    DrawThemeTextBox(CFSTR("Picture controls"),kThemeSmallSystemFont,inState,false,&theRect,
        teJustLeft,NULL);
    SetRect(&theRect,313,235,463,250);
    DrawThemeTextBox(CFSTR("Icon controls (cicn)"),kThemeSmallSystemFont,inState,false,
        &theRect,teJustLeft,NULL);
    SetRect(&theRect,451,235,601,250);
    DrawThemeTextBox(CFSTR("Icon controls (icon suite)"),kThemeSmallSystemFont,inState,false,
        &theRect,teJustLeft,NULL);
}
}

// ***** helpTagsBevelImagePictIcon

void helpTagsBevelImagePictIcon(WindowRef windowRef)
{
    BevelDocStrucHandle bevelDocStrucHdl;
    HMHelpContentRec helpContent;

    bevelDocStrucHdl = (BevelDocStrucHandle) (GetWRefCon(windowRef));

    memset(&helpContent,0,sizeof(helpContent));
    HMSetTagDelay(500);
    HMSetHelpTagsDisplayed(true);

    helpContent.version = kMacHelpVersion;
    helpContent.tagSide = kHMOutsideTopCenterAligned;
    helpContent.content[kHMMMinimumContentIndex].contentType = kHMStringResContent;
    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmResID = 132;

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 1;
    HMSetControlHelpContent(( *bevelDocStrucHdl ->bevelButton1Ref,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 2;
    HMSetControlHelpContent(( *bevelDocStrucHdl ->bevelButton2Ref,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 3;
    HMSetControlHelpContent(( *bevelDocStrucHdl ->bevelButton3Ref,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 4;
    HMSetControlHelpContent(( *bevelDocStrucHdl ->bevelButton4Ref,&helpContent);

    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 5;
    HMSetControlHelpContent(( *bevelDocStrucHdl ->bevelButton5Ref,&helpContent);

```

```
helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 6;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton6Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 7;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton7Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 8;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton8Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 9;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton9Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 10;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton10Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 10;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton11Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 10;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton12Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 11;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton13Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 11;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton14Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 11;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton15Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 12;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton16Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 13;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton17Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 14;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton18Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 15;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton19Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 16;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton20Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 17;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->bevelButton21Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 18;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->imageWell1Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 19;
HMSetControlHelpContent(( *bevelDocStrucHdl) ->imageWell2Ref,&helpContent);
```

```

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 20;
HMSetControlHelpContent(( *bevelDocStrucHdl ->picture1Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 21;
HMSetControlHelpContent(( *bevelDocStrucHdl ->picture2Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 22;
HMSetControlHelpContent(( *bevelDocStrucHdl ->colorIcon1Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 23;
HMSetControlHelpContent(( *bevelDocStrucHdl ->colorIcon2Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 24;
HMSetControlHelpContent(( *bevelDocStrucHdl ->iconSuite1Ref,&helpContent);

helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 25;
HMSetControlHelpContent(( *bevelDocStrucHdl ->iconSuite2Ref,&helpContent);
}

// *****
// TabEditClock.c
// *****

// ..... includes

#include "Controls3.h"

// ..... global variables

extern Boolean gRunningOnX;

// ***** doTabEditClock

void doTabEditClock(void)
{
    DialogRef          dialogRef;
    ControlRef         controlRef;
    Str255             initialName = "\pYour name here";
    ControlEditTextSelectionRec selectionRec;
    ControlKeyFilterUPP numericFilterUPP;
    ModalFilterUPP      eventFilterUPP;
    ControlEditTextValidationUPP editTextValidatorUPP;
    SInt16              tabHit, itemHit;

    if(FrontNonFloatingWindow())
        doActivateWindow(FrontNonFloatingWindow(),false);

    if(!(dialogRef = GetNewDialog(rTabEditClockDialog,NULL,(WindowRef) -1)))
        ExitToShell();

    SetWTitle(GetDialogWindow(dialogRef),"\pTab, Edit Text, and Clock Controls");
    SetPortDialogPort(dialogRef);

```

```

// ..... set default button and cursor tracking

SetDialogDefaultItem(dialogRef, kStdOkItemIndex);
SetDialogTracksCursor(dialogRef, true);

// ..... hide user pane with embedded clocks

GetDialogItemAsControl(dialogRef, iClocksUserPane, &controlRef);
HideControl(controlRef);

// ..... assign some text to the first edit text control and select the whole text

GetDialogItemAsControl(dialogRef, iEditText1, &controlRef);
SetControlData(controlRef, kControlEntireControl, kControlEditTextTextTag, initialName[0],
               &initialName[1]);
selectionRec.selStart = 0;
selectionRec.selEnd = 32767;
SetControlData(controlRef, kControlEntireControl, kControlEditTextSelectionTag,
               sizeof(selectionRec), &selectionRec);

// create universal procedure pointers for event filter, key filter, and edit text validator

eventFilterUPP      = NewModalFilterUPP((ModalFilterProcPtr) eventFilter);
numericFilterUPP    = NewControlKeyFilterUPP((ControlKeyFilterProcPtr) numericFilter);
editTextValidatorUPP = NewControlEditTextValidationUPP((ControlEditTextValidationProcPtr)
                                                       editTextValidator);

// ..... attach an edit text validation function to the first edit text control

GetDialogItemAsControl(dialogRef, iEditText1, &controlRef);
SetControlData(controlRef, kControlEntireControl, kControlEditTextValidationProcTag,
               sizeof(editTextValidatorUPP), &editTextValidatorUPP);

// ..... attach a key filter function to the second edit text control

GetDialogItemAsControl(dialogRef, iEditText2, &controlRef);
SetControlData(controlRef, kControlEntireControl, kControlEditTextKeyFilterTag,
               sizeof(numericFilterUPP), &numericFilterUPP);

// ..... set help tags, show dialog, and enter modal dialog loop

if(gRunningOnX)
    helpTagsTabEditClock(dialogRef);

ShowWindow(GetDialogWindow(dialogRef));

do
{
    ModalDialog(eventFilterUPP, &itemHit);

    if(itemHit == iTabs)
    {
        GetDialogItemAsControl(dialogRef, iTabs, &controlRef);
        tabHit = GetControlValue(controlRef);
    }
}

```

```

        if(tabHit == tabEditText)
        {
            SetWTitle(GetDialogWindow(dialogRef), "\pTab, Edit Text, and Clock Controls");

            GetDialogItemAsControl(dialogRef, iClocksUserPane, &controlRef);
            HideControl(controlRef);

            GetDialogItemAsControl(dialogRef, iEditTextUserPane, &controlRef);
            ActivateControl(controlRef);
            ShowControl(controlRef);

            GetDialogItemAsControl(dialogRef, iEditText1, &controlRef);
            SetKeyboardFocus(GetDialogWindow(dialogRef), controlRef, kControlFocusNextPart);
        }
        else if(tabHit == tabClocks)
        {
            SetWTitle(GetDialogWindow(dialogRef), "\pTab, Clock, and Edit Text Controls");

            GetDialogItemAsControl(dialogRef, iEditTextUserPane, &controlRef);
            DeactivateControl(controlRef);
            HideControl(controlRef);

            GetDialogItemAsControl(dialogRef, iClocksUserPane, &controlRef);
            ShowControl(controlRef);

            GetDialogItemAsControl(dialogRef, iClocks1, &controlRef);
            SetKeyboardFocus(GetDialogWindow(dialogRef), controlRef, kControlFocusNextPart);
        }
    }
    else if(itemHit == iExtractEditText)
    {
        GetDialogItemAsControl(dialogRef, iImageWellEditText, &controlRef);
        Draw1Control(controlRef);
        doExtractEditText(dialogRef);
    }
    else if(itemHit == iExtractClocks)
    {
        GetDialogItemAsControl(dialogRef, iImageWellClocks, &controlRef);
        Draw1Control(controlRef);
        doExtractDateTime(dialogRef);
    }
} while(itemHit != kStdOkItemIndex);

DisposeDialog(dialogRef);
DisposeModalFilterUPP(eventFilterUPP);
DisposeControlKeyFilterUPP(numericFilterUPP);
DisposeControlEditTextValidationUPP(editTextValidatorUPP);
}

```

```
// ***** doExtractEditText

void doExtractEditText(DialogRef dialogRef)
{
    GrafPtr    oldPort;
    RGBColor    saveBackColor, whiteColor = { 0xFFFF, 0xFFFF, 0xFFFF };
    SInt16      iType;
    Handle      theHandle;
    Rect        theRect;
    Str255      theString;
    CFStringRef stringRef;
    ControlRef  controlRef;
    Size        actualSize;

    GetPort(&oldPort);
    SetPortDialogPort(dialogRef);
    GetBackColor(&saveBackColor);
    RGBBackColor(&whiteColor);

    GetDialogItem(dialogRef, iEditText1, &iType, &theHandle, &theRect);
    GetDialogItemText(theHandle, theString);
    if(!gRunningOnX)
    {
        MoveTo(124, 177);
        DrawString(theString);
    }
    else
    {
        stringRef = CFStringCreateWithPascalString(NULL, theString, kCFStringEncodingMacRoman);
        SetRect(&theRect, 124, 166, 314, 181);
        DrawThemeTextBox(stringRef, kThemeSmallSystemFont, true, false, &theRect, teJustLeft, NULL);
    }

    GetDialogItem(dialogRef, iEditText2, &iType, &theHandle, &theRect);
    GetDialogItemText(theHandle, theString);
    if(!gRunningOnX)
    {
        MoveTo(124, 190);
        DrawString(theString);
    }
    else
    {
        stringRef = CFStringCreateWithPascalString(NULL, theString, kCFStringEncodingMacRoman);
        SetRect(&theRect, 124, 179, 314, 194);
        DrawThemeTextBox(stringRef, kThemeSmallSystemFont, true, false, &theRect, teJustLeft, NULL);
    }

    GetDialogItemAsControl(dialogRef, iEditText3, &controlRef);
    GetControlDataSize(controlRef, kControlEditTextPart, kControlEditTextTextTag, &actualSize);
    GetControlData(controlRef, kControlEntireControl, kControlEditTextPasswordTag, actualSize,
        &theString[1], NULL);
    theString[0] = actualSize;
    if(!gRunningOnX)
```



```

    {
        MoveTo(124,203);
        DrawString(theString);
    }
    else
    {
        stringRef = CFStringCreateWithPascalString(NULL,theString,kCFStringEncodingMacRoman);
        SetRect(&theRect,124,192,314,207);
        DrawThemeText(TextBox,stringRef,kThemeSmallSystemFont,true,false,&theRect,teJustLeft,NULL);
    }

    if(gRunningOnX)
    {
        if(stringRef != NULL)
            CFRelease(stringRef);
    }

    RGBBackColor(&saveBackColor);
    SetPort(oldPort);
}

// ***** doExtractDateTime

void doExtractDateTime(DialogRef dialogRef)
{
    GrafPtr    oldPort;
    RGBColor    saveBackColor, whiteColor = { 0xFFFF, 0xFFFF, 0xFFFF };
    ControlRef  controlRef;
    LongDateRec longDateTimeStruc;
    SInt16      second, minute, hour, day, month, year;
    Str255      theString, tempString;
    CFStringRef stringRef;
    Rect        theRect;

    GetPort(&oldPort);
    SetPortDialogPort(dialogRef);
    GetBackColor(&saveBackColor);
    RGBBackColor(&whiteColor);

    GetDialogItemAsControl(dialogRef,iClocks1,&controlRef);
    GetControlData(controlRef,kControlEntireControl,kControlClockLongDateTag,
        sizeof(longDateTimeStruc),&longDateTimeStruc,NULL);
    hour = longDateTimeStruc.ld.hour;
    minute = longDateTimeStruc.ld.minute;
    second = longDateTimeStruc.ld.second;
    doCopyPString("\pHour ",theString);
    NumToString((SInt32) hour,tempString);
    doConcatPStrings(theString,tempString);
    doConcatPStrings(theString,"\p, Minute ");
    NumToString((SInt32) minute,tempString);
    doConcatPStrings(theString,tempString);
    doConcatPStrings(theString,"\p, Second ");
    NumToString((SInt32) second,tempString);
    doConcatPStrings(theString,tempString);
}

```

```

MoveTo(124,177);
if (!gRunningOnX)
    DrawString(theString);
else
{
    stringRef = CFStringCreateWithPascalString(NULL, theString, kCFStringEncodingMacRoman);
    SetRect(&theRect, 124, 166, 314, 181);
    DrawThemeTextBox(stringRef, kThemeSmallSystemFont, true, false, &theRect, teJustLeft, NULL);
    if (stringRef != NULL)
        CFRelease(stringRef);
}

GetDialogItemAsControl(dialogRef, iClocks2, &controlRef);
GetControlData(controlRef, kControlEntireControl, kControlClockLongDateTag,
    sizeof(longDateTimeStruc), &longDateTimeStruc, NULL);
day = longDateTimeStruc.ld.day;
month = longDateTimeStruc.ld.month;
year = longDateTimeStruc.ld.year;
doCopyPString("\pDay ", theString);
NumToString((SInt32) day, tempString);
doConcatPStrings(theString, tempString);
doConcatPStrings(theString, "\p, Month ");
NumToString((SInt32) month, tempString);
doConcatPStrings(theString, tempString);
doConcatPStrings(theString, "\p, Year ");
NumToString((SInt32) year, tempString);
doConcatPStrings(theString, tempString);
MoveTo(124,190);
if (!gRunningOnX)
    DrawString(theString);
else
{
    stringRef = CFStringCreateWithPascalString(NULL, theString, kCFStringEncodingMacRoman);
    SetRect(&theRect, 124, 179, 314, 194);
    DrawThemeTextBox(stringRef, kThemeSmallSystemFont, true, false, &theRect, teJustLeft, NULL);
    if (stringRef != NULL)
        CFRelease(stringRef);
}

GetDialogItemAsControl(dialogRef, iClocks3, &controlRef);
GetControlData(controlRef, kControlEntireControl, kControlClockLongDateTag,
    sizeof(longDateTimeStruc), &longDateTimeStruc, NULL);
month = longDateTimeStruc.ld.month;
year = longDateTimeStruc.ld.year;
doCopyPString("\pMonth ", theString);
NumToString((SInt32) month, tempString);
doConcatPStrings(theString, tempString);
doConcatPStrings(theString, "\p, Year ");
NumToString((SInt32) year, tempString);
doConcatPStrings(theString, tempString);
MoveTo(124,203);
if (!gRunningOnX)
    DrawString(theString);
else

```

```

    {
        stringRef = CFStringCreateWithPascalString(NULL, theString, kCFStringEncodingMacRoman);
        SetRect(&theRect, 124, 192, 314, 207);
        DrawThemeTextBox(stringRef, kThemeSmallSystemFont, true, false, &theRect, teJustLeft, NULL);
        if(stringRef != NULL)
            CFRelease(stringRef);
    }

    RGBBackColor(&saveBackColor);
    SetPort(oldPort);
}

// ***** numericFilter

ControlKeyFilterResult numericFilter(ControlRef controlRef, SInt16* keyCode, SInt16 *charCode,
                                     EventModifiers *modifiers)
{
    if(((char) *charCode >= '0') && ((char) *charCode <= '9') ||
        (BitTst(modifiers, 15 - cmdKeyBit)))
    {
        return kControlKeyFilterPassKey;
    }

    switch(*charCode)
    {
        case kLeftArrow:
        case kRightArrow:
        case kUpArrow:
        case kDownArrow:
        case kBackspace:
        case kDelete:
            return kControlKeyFilterPassKey;
            break;
    }

    SysBeep(10);
    return kControlKeyFilterBlockKey;
}

// ***** editTextValidator

void editTextValidator(ControlRef controlRef)
{
    Str255 oldText, newText;
    Size actualSize;
    UInt8 a, count = 0;

    GetControlData(controlRef, kControlEntireControl, kControlEditTextTextTag, sizeof(oldText) - 1,
                   &oldText[1], &actualSize);

    if(actualSize <= 255)
        oldText[0] = actualSize;
    else
        oldText[0] = 255;
}

```

```

for(a=1;a<=oldText[0];a++)
{
    if(((oldText[a] >= 'A') && (oldText[a] <= 'Z')) ||
        (oldText[a] >= 'a') && (oldText[a] <= 'z')) ||
        (oldText[a] == ' ') || (oldText[a] == '.'))
    {
        newText[count + 1] = oldText[a];
        count++;
    }
}

newText[0] = count;

SetControlData(controlRef,kControlEntireControl,kControlEditTextTextTag,newText[0],
    &newText[1]);

Draw1Control(controlRef);
}

// ***** helpTagsTabEditClock

void helpTagsTabEditClock(DialogRef dialogRef)
{
    HMHelpContentRec helpContent;
    SInt16 a;
    static SInt16 itemNumber[10] = { 2,5,7,9,11,21,14,16,18,20 };
    ControlRef controlRef;

    memset(&helpContent,0,sizeof(helpContent));
    HMSetTagDelay(500);
    HMSetHelpTagsDisplayed(true);

    helpContent.version = kMacHelpVersion;
    helpContent.tagSide = kHMOutsideTopCenterAligned;
    helpContent.content[kHMMMinimumContentIndex].contentType = kHMStringResContent;
    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmResID = 133;

    for(a = 1;a <= 10; a++)
    {
        helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = a;
        GetDialogItemAsControl(dialogRef,itemNumber[a - 1],&controlRef);
        HMSetControlHelpContent(controlRef,&helpContent);
    }
}

// *****
// GroupArrowsProgress.c
// *****

// ..... includes

#include "Controls3.h"

```

```

// ..... global variables

ControlRef      gCacheSizeControlRef;
ControlRef      gLittleArrowsControlRef;
ControlActionUPP gArrowsActionFunctionUPP;
extern Boolean   gRunningOnX;
extern Boolean   gGroupArrowsProgressActive;

// ***** doGroupArrowsProgress

void doGroupArrowsProgress(void)
{
    DialogRef      dialogRef;
    ControlRef      controlRef;
    ModalFilterUPP eventFilterUPP;
    SInt16          controlValue, itemHit;
    Str255          theString;

    if(FrontNonFloatingWindow())
        doActivateWindow(FrontNonFloatingWindow(),false);

    if(!(dialogRef = GetNewDialog(rGroupArrowsProgDialog,NULL,(WindowRef) -1)))
        ExitToShell();

    SetPortDialogPort(dialogRef);

    // ..... set default button, help tags

    SetDialogDefaultItem(dialogRef,kStdOkItemIndex);

    // ..... create universal procedure pointers for event filter and little arrows action function

    eventFilterUPP      = NewModalFilterUPP((ModalFilterProcPtr) eventFilter);
    gArrowsActionFunctionUPP = NewControlActionUPP((ControlActionProcPtr) arrowsActionFunction);

    // ..... set initial value for checkbox group box

    GetDialogItemAsControl(dialogRef,iCheckboxGroup,&controlRef);
    SetControlValue(controlRef,1);

    // ..... get and set initial cache value for little arrows

    GetDialogItemAsControl(dialogRef,iLittleArrows,&gLittleArrowsControlRef);
    NumToString((SInt32) GetControlValue(gLittleArrowsControlRef),theString);
    doConcatPStrings(theString,"\\pK");
    GetDialogItemAsControl(dialogRef,iStaticTextCache,&gCacheSizeControlRef);
    SetControlData(gCacheSizeControlRef,kControlEntireControl,kControlStaticTextTextTag,
        theString[0],&theString[1]);

    // ..... hide second user pane in pop-up group box

    GetDialogItemAsControl(dialogRef,iUserPaneScoreAverage,&controlRef);
    HideControl(controlRef);

```

```

// ..... set help tags, show dialog, and enter ModalDialog loop

if(gRunningOnX)
    helpTagsGroupArrowsProgress(dialogRef);

ShowWindow(GetDialogWindow(dialogRef));

do
{
    ModalDialog(eventFilterUPP,&itemHit);

    if(itemHit == iCheckboxGroup)
    {
        doCheckBoxGroupBox(dialogRef);
    }
    else if(itemHit == iPopupGroup)
    {
        doPopupGroupBox(dialogRef);
    }
    else if(itemHit == iCheckboxShowInitials)
    {
        GetDialogItemAsControl(dialogRef,iCheckboxShowInitials,&controlRef);
        controlValue = (!GetControlValue(controlRef));
        SetControlValue(controlRef,controlValue);
    }
    else if(itemHit == iCheckboxShowAverages)
    {
        GetDialogItemAsControl(dialogRef,iCheckboxShowAverages,&controlRef);
        controlValue = (!GetControlValue(controlRef));
        SetControlValue(controlRef,controlValue);
    }
    else if(itemHit == iDisclosureTriangle)
    {
        doChasingAndProgress(dialogRef);
    }
    else if(itemHit == iPushButtonExtract)
    {
        GetDialogItemAsControl(dialogRef,iImageWell,&controlRef);
        Draw1Control(controlRef);
        doExtractCurrentStatus(dialogRef);
    }
} while(itemHit != kStdOkItemIndex);

// ..... clean up

DisposeDialog(dialogRef);
DisposeModalFilterUPP(eventFilterUPP);
DisposeControlActionUPP(gArrowsActionFunctionUPP);

gGroupArrowsProgressActive = false;
}

```

```
// ***** doCheckBoxGroupBox

void doCheckBoxGroupBox(DialogRef dialogRef)
{
    ControlRef controlRef;
    SInt16      controlValue;

    GetDialogItemAsControl(dialogRef,iCheckboxGroup,&controlRef);
    controlValue = (!GetControlValue(controlRef));
    SetControlValue(controlRef,controlValue);

    if(controlValue == 0)
    {
        GetDialogItemAsControl(dialogRef,iRadioGroupColor,&controlRef);
        DeactivateControl(controlRef);
        GetDialogItemAsControl(dialogRef,iStaticTextColorDepth,&controlRef);
        DeactivateControl(controlRef);
    }
    else if(controlValue == 1)
    {
        GetDialogItemAsControl(dialogRef,iRadioGroupColor,&controlRef);
        ActivateControl(controlRef);
        GetDialogItemAsControl(dialogRef,iStaticTextColorDepth,&controlRef);
        ActivateControl(controlRef);
    }
}

// ***** doPopupGroupBox

void doPopupGroupBox(DialogRef dialogRef)
{
    ControlRef controlRef;
    SInt16      controlValue;

    GetDialogItemAsControl(dialogRef,iPopupGroup,&controlRef);
    controlValue = GetControlValue(controlRef);

    if(controlValue == 1)
    {
        GetDialogItemAsControl(dialogRef,iUserPaneScoreAverage,&controlRef);
        HideControl(controlRef);
        GetDialogItemAsControl(dialogRef,iUserPaneNamesInitials,&controlRef);
        ShowControl(controlRef);
    }
    else if(controlValue == 2)
    {
        GetDialogItemAsControl(dialogRef,iUserPaneNamesInitials,&controlRef);
        HideControl(controlRef);
        GetDialogItemAsControl(dialogRef,iUserPaneScoreAverage,&controlRef);
        ShowControl(controlRef);
    }
}
}
```



```
// ***** doChasingAndProgress

void doChasingAndProgress(DialogRef dialogRef)
{
    ControlRef controlRef;
    SInt16      controlValue;
    Handle      ditlHdl;
    Boolean      indeterminateFlag = 1;
    Str255      expandString      = "\pHide Progress Bar and Chasing Arrows";
    Str255      collapseString    = "\pShow Progress Bar and Chasing Arrows";

    GetDialogItemAsControl(dialogRef,iDisclosureTriangle,&controlRef);
    controlValue = (!GetControlValue(controlRef));
    SetControlValue(controlRef,controlValue);

    if(controlValue == 1)
    {
        ditlHdl = GetResource('DITL',130);
        AppendDITL(dialogRef,ditlHdl,appendDITLBottom);
        ReleaseResource(ditlHdl);

        GetDialogItemAsControl(dialogRef,iProgressBar,&controlRef);
        SetControlData(controlRef,kControlEntireControl,kControlProgressBarIndeterminateTag,
            sizeof(indeterminateFlag),&indeterminateFlag);

        GetDialogItemAsControl(dialogRef,kStdOkItemIndex,&controlRef);
        MoveControl(controlRef,277,351);

        GetDialogItemAsControl(dialogRef,iStaticTextDisclosure,&controlRef);
        SetControlData(controlRef,kControlEntireControl,kControlStaticTextTextTag,
            expandString[0],&expandString[1]);
        Draw1Control(controlRef);
    }
    else if(controlValue == 0)
    {
        GetDialogItemAsControl(dialogRef,kStdOkItemIndex,&controlRef);
        MoveControl(controlRef,277,280);

        ShortenDITL(dialogRef,3);
        SizeWindow(GetDialogWindow(dialogRef),362,321,false);

        GetDialogItemAsControl(dialogRef,iStaticTextDisclosure,&controlRef);
        SetControlData(controlRef,kControlEntireControl,kControlStaticTextTextTag,
            collapseString[0],&collapseString[1]);
        Draw1Control(controlRef);
    }
}

// ***** doExtractCurrentStatus
```

```

void doExtractCurrentStatus(DialogRef dialogRef)
{
    GrafPtr    oldPort;
    RGBColor    saveBackColor, whiteColor = { 0xFFFF, 0xFFFF, 0xFFFF };
    ControlRef  controlRef;
    SInt16      controlValue;
    Str255      theString;
    CFStringRef  stringRef;
    Rect        theRect;

    GetPort(&oldPort);
    SetPortDialogPort(dialogRef);
    GetBackColor(&saveBackColor);
    RGBBackColor(&whiteColor);

    GetDialogItemAsControl(dialogRef, iCheckboxGroup, &controlRef);
    controlValue = GetControlValue(controlRef);
    if(controlValue)
    {
        doCopyPString("\pUse color.", theString);
        GetDialogItemAsControl(dialogRef, iRadioGroupColor, &controlRef);
        controlValue = GetControlValue(controlRef);
        if(controlValue == 1)
            doConcatPStrings(theString, "\p 8 bit.");
        else if(controlValue == 2)
            doConcatPStrings(theString, "\p 16 bit.");
        else if(controlValue == 3)
            doConcatPStrings(theString, "\p 32 bit.");
    }
    else
        doCopyPString("\pDont use color.", theString);

    if(!gRunningOnX)
    {
        MoveTo(108, 216);
        DrawString(theString);
    }
    else
    {
        stringRef = CFStringCreateWithPascalString(NULL, theString, kCFStringEncodingMacRoman);
        SetRect(&theRect, 108, 205, 347, 220);
        DrawThemeTextBox(stringRef, kThemeSmallSystemFont, true, false, &theRect, teJustLeft, NULL);
        if(stringRef != NULL)
            CFRelease(stringRef);
    }

    GetDialogItemAsControl(dialogRef, iPopupGroup, &controlRef);
    controlValue = GetControlValue(controlRef);
    if(controlValue == 1)
    {
        doCopyPString("\pPlayer, ", theString);
        GetDialogItemAsControl(dialogRef, iRadioGroupNames, &controlRef);
        controlValue = GetControlValue(controlRef);
    }
}

```

```

    if(controlValue == 1)
        doConcatPStrings(theString, "\pname first,");
    else if(controlValue == 2)
        doConcatPStrings(theString, "\pname last,");
    GetDialogItemAsControl(dialogRef, iCheckboxShowInitials, &controlRef);
    controlValue = GetControlValue(controlRef);
    if(controlValue == 1)
        doConcatPStrings(theString, "\p show number.");
    else if(controlValue == 0)
        doConcatPStrings(theString, "\p no number.");
}
else if(controlValue == 2)
{
    doCopyPString("\pScore, ", theString);
    GetDialogItemAsControl(dialogRef, iRadioGroupScores, &controlRef);
    controlValue = GetControlValue(controlRef);
    if(controlValue == 1)
        doConcatPStrings(theString, "\pbatting, ");
    else if(controlValue == 2)
        doConcatPStrings(theString, "\pbowling, ");
    GetDialogItemAsControl(dialogRef, iCheckboxShowAverages, &controlRef);
    controlValue = GetControlValue(controlRef);
    if(controlValue == 1)
        doConcatPStrings(theString, "\pshow average.");
    else if(controlValue == 0)
        doConcatPStrings(theString, "\pno average.");
}

if(!gRunningOnX)
{
    MoveTo(108, 229);
    DrawString(theString);
}
else
{
    stringRef = CFStringCreateWithPascalString(NULL, theString, kCFStringEncodingMacRoman);
    SetRect(&theRect, 108, 219, 347, 234);
    DrawThemeTextBox(stringRef, kThemeSmallSystemFont, true, false, &theRect, teJustLeft, NULL);
    if(stringRef != NULL)
        CFRelease(stringRef);
}

if(!gRunningOnX)
{
    MoveTo(108, 242);
    DrawString("\pCache size: ");
}
else
{
    stringRef = CFStringCreateWithPascalString(NULL, "\pCache size: ",
                                                kCFStringEncodingMacRoman);
    SetRect(&theRect, 108, 232, 347, 247);
    DrawThemeTextBox(stringRef, kThemeSmallSystemFont, true, false, &theRect, teJustLeft, NULL);
    if(stringRef != NULL)
        CFRelease(stringRef);
}
}

```

```

GetDialogItemAsControl(dialogRef, iLittleArrows, &controlRef);
NumToString((SInt32) GetControlValue(controlRef), theString);
if(!gRunningOnX)
    DrawString(theString);
else
{
    stringRef = CFStringCreateWithPascalString(NULL, theString, kCFStringEncodingMacRoman);
    SetRect(&theRect, 174, 232, 347, 247);
    DrawThemeTextBox(stringRef, kThemeSmallSystemFont, true, false, &theRect, teJustLeft, NULL);
    if(stringRef != NULL)
        CFRelease(stringRef);
}

RGBBackColor(&saveBackColor);
SetPort(oldPort);
}

// ***** helpTagsGroupArrowsProgress

void helpTagsGroupArrowsProgress(DialogRef dialogRef)
{
    HMHelpContentRec helpContent;
    SInt16 a;
    static SInt16 itemNumber[8] = { 2, 9, 21, 25, 27, 29, 31, 32 };
    ControlRef controlRef;

    memset(&helpContent, 0, sizeof(helpContent));
    HMSetTagDelay(500);
    HMSetHelpTagsDisplayed(true);

    helpContent.version = kMacHelpVersion;
    helpContent.tagSide = kHMOutsideTopCenterAligned;
    helpContent.content[kHMMMinimumContentIndex].contentType = kHMStringResContent;
    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmResID = 134;

    for(a = 1; a <= 8; a++)
    {
        helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = a;
        GetDialogItemAsControl(dialogRef, itemNumber[a - 1], &controlRef);
        HMSetControlHelpContent(controlRef, &helpContent);
    }
}

// *****
// Sliders.c
// *****

// ..... includes

#include "Controls3.h"

```

```
// ..... global variables

extern Boolean gRunningOnX;

// ..... global variables

ControlActionUPP      gSliderActionFunction1UPP;
ControlActionUPP      gSliderActionFunction2UPP;
ControlUserPaneDrawUPP gUserPaneDrawFunctionUPP;
ControlUserPaneActivateUPP gUserPaneActivateFunctionUPP;
ControlRef            gSlider1Ref;
ControlRef            gSlider2Ref;
ControlRef            gSlider3Ref;
ControlRef            gSlider4Ref;
ControlRef            gSlider5Ref;
ControlRef            gSlider6Ref;
RGBColor              gRedColor;
RGBColor              gBlueColor;
RGBColor              gBlackColor = { 0x0000, 0x0000, 0x0000 };
Boolean               gDrawActivated = true;
extern Boolean         gSlidersActive;

// ***** doSliderUserPane

void doSliderUserPane(void)
{
    DialogRef    dialogRef;
    ModalFilterUPP eventFilterUPP;
    ControlRef    controlRef;
    SInt16        itemHit;

    if(FrontNonFloatingWindow())
        doActivateWindow(FrontNonFloatingWindow(),false);

    if(!(dialogRef = GetNewDialog(rSlidersDialog,NULL,(WindowRef) -1)))
        ExitToShell();

    // ..... set default button

    SetDialogDefaultItem(dialogRef,kStdOKItemIndex);

    // ..... create universal procedure pointer for event filter function

    eventFilterUPP = NewModalFilterUPP((ModalFilterProcPtr) eventFilter);

    // ..... create universal procedure pointers for slider action functions

    gSliderActionFunction1UPP = NewControlActionUPP((ControlActionProcPtr)
        sliderActionFunction1);
    gSliderActionFunction2UPP = NewControlActionUPP((ControlActionProcPtr)
        sliderActionFunction2);
}
```

```

// ..... create universal procedure pointers for user pane functions, set user pane functions

gUserPaneDrawFunctionUPP = NewControlUserPaneDrawUPP((ControlUserPaneDrawProcPtr)
                                                    userPaneDrawFunction);
GetDialogItemAsControl(dialogRef,iUserPane1,&controlRef);
SetControlData(controlRef,kControlEntireControl,kControlUserPaneDrawProcTag,
                sizeof(gUserPaneDrawFunctionUPP),&gUserPaneDrawFunctionUPP);

gUserPaneActivateFunctionUPP = NewControlUserPaneActivateUPP((ControlUserPaneActivateProcPtr)
                                                            userPaneActivateFunction);
GetDialogItemAsControl(dialogRef,iUserPane1,&controlRef);
SetControlData(controlRef,kControlEntireControl,kControlUserPaneActivateProcTag,
                sizeof(gUserPaneActivateFunctionUPP),&gUserPaneActivateFunctionUPP);

// ..... get control handles of, and draw initial control values for, top four sliders

GetDialogItemAsControl(dialogRef,iSlider1,&gSlider1Ref);
doDrawSliderValues(dialogRef,gSlider1Ref);
GetDialogItemAsControl(dialogRef,iSlider2,&gSlider2Ref);
doDrawSliderValues(dialogRef,gSlider2Ref);
GetDialogItemAsControl(dialogRef,iSlider3,&gSlider3Ref);
doDrawSliderValues(dialogRef,gSlider3Ref);
GetDialogItemAsControl(dialogRef,iSlider4,&gSlider4Ref);
doDrawSliderValues(dialogRef,gSlider4Ref);

// ..... get control handles and values for bottom two sliders, set color

GetDialogItemAsControl(dialogRef,iSlider5,&gSlider5Ref);
gRedColor.red = 2 * GetControlValue(gSlider5Ref);
GetDialogItemAsControl(dialogRef,iSlider6,&gSlider6Ref);
gBlueColor.blue = 2 * GetControlValue(gSlider5Ref);

// ..... set help tags, show dialog, and enter ModalDialog loop

if(gRunningOnX)
    helpTagsSliders(dialogRef);

ShowWindow(GetDialogWindow(dialogRef));

do
{
    ModalDialog(eventFilterUPP,&itemHit);
} while(itemHit != kStdOkItemIndex);

// ..... clean up

DisposeDialog(dialogRef);
DisposeModalFilterUPP(eventFilterUPP);
DisposeControlActionUPP(gSliderActionFunction1UPP);
DisposeControlActionUPP(gSliderActionFunction2UPP);
DisposeControlUserPaneDrawUPP(gUserPaneDrawFunctionUPP);
DisposeControlUserPaneActivateUPP(gUserPaneActivateFunctionUPP);
gSlidersActive = false;
}

```

```
// ***** doDrawSliderValues
```

```
void doDrawSliderValues(DialogRef dialogRef,ControlRef controlRef)
{
    Str255 theString;
    SInt16 staticTextItem;

    NumToString((SInt32) GetControlValue(controlRef),theString);

    if(controlRef == gSlider1Ref)
        staticTextItem = iSlider1StaticText;
    else if(controlRef == gSlider2Ref)
        staticTextItem = iSlider2StaticText;
    else if(controlRef == gSlider3Ref)
        staticTextItem = iSlider3StaticText;
    else if(controlRef == gSlider4Ref)
        staticTextItem = iSlider4StaticText;

    GetDialogItemAsControl(dialogRef,staticTextItem,&controlRef);
    SetControlData(controlRef,kControlEntireControl,kControlStaticTextTextTag,theString[0],
        &theString[1]);
    Draw1Control(controlRef);
}
```

```
// ***** userPaneDrawFunction
```

```
void userPaneDrawFunction(ControlRef theControl,SInt16 thePart)
{
    Rect theRect;

    SetRect(&theRect,218,175,238,195);
    DrawThemePlacard(&theRect,gDrawActivated);
    InsetRect(&theRect,2,2);

    if(gDrawActivated)
    {
        RGBForeColor(&gRedColor);
        PaintRect(&theRect);
    }

    SetRect(&theRect,218,196,238,216);
    DrawThemePlacard(&theRect,gDrawActivated);
    InsetRect(&theRect,2,2);

    if(gDrawActivated)
    {
        RGBForeColor(&gBlueColor);
        PaintRect(&theRect);
    }
}
```



```
// ***** userPaneActivateFunction

void userPaneActivateFunction(ControlRef control, Boolean activating)
{
    if(activating)
        gDrawActivated = true;
    else
        gDrawActivated = false;
}

// ***** helpTagsSliders

void helpTagsSliders(DialogRef dialogRef)
{
    HMHelpContentRec helpContent;
    SInt16 a;
    static SInt16 itemNumber[7] = { 2,3,4,5,17,19,18 };
    ControlRef controlRef;

    memset(&helpContent, 0, sizeof(helpContent));
    HMSetTagDelay(500);
    HMSetHelpTagsDisplayed(true);

    helpContent.version = kMacHelpVersion;
    helpContent.tagSide = kHMOutsideTopCenterAligned;
    helpContent.content[kHMMinimumContentIndex].contentType = kHMStringResContent;
    helpContent.content[kHMMinimumContentIndex].u.tagStringRes.hmmResID = 135;

    for(a = 1; a <= 7; a++)
    {
        helpContent.content[kHMMinimumContentIndex].u.tagStringRes.hmmIndex = a;
        GetDialogItemAsControl(dialogRef, itemNumber[a - 1], &controlRef);
        HMSetControlHelpContent(controlRef, &helpContent);
    }
}

// *****
// TextBox.c
// *****

// ..... includes

#include "Controls3.h"

// ***** doTextBox

void doTextBox(void)
{
    DialogRef dialogRef;
    ModalFilterUPP eventFilterUPP;
    SInt16 itemHit;

    if(FrontNonFloatingWindow())
        doActivateWindow(FrontNonFloatingWindow(), false);
}
```

```

if(!(dialogRef = GetNewDialog(rAboutDialog, NULL, (WindowRef) -1)))
    ExitToShell();

// ..... set default button

SetDialogDefaultItem(dialogRef, kStdOkItemIndex);

// ..... create universal procedure pointer for event filter

eventFilterUPP = NewModalFilterUPP((ModalFilterProcPtr) eventFilter);

// ..... show dialog and enter modal dialog loop

ShowWindow(GetDialogWindow(dialogRef));

do
{
    ModalDialog(eventFilterUPP, &itemHit);
} while(itemHit != kStdOkItemIndex);

DisposeDialog(dialogRef);
DisposeModalFilterUPP(eventFilterUPP);
}

// *****
// Callbacks.c
// *****

// ..... includes

#include "Controls3.h"

// ..... global variables

extern Boolean      gGroupArrowsProgressActive;
extern Boolean      gSlidersActive;
extern ControlActionUPP gArrowsActionFunctionUPP;
extern ControlActionUPP gSliderActionFunction1UPP;
extern ControlActionUPP gSliderActionFunction2UPP;
extern ControlRef    gLittleArrowsControlRef;
extern ControlRef    gCacheSizeControlRef;
extern ControlRef    gSlider1Ref;
extern ControlRef    gSlider2Ref;
extern ControlRef    gSlider3Ref;
extern ControlRef    gSlider4Ref;
extern ControlRef    gSlider5Ref;
extern ControlRef    gSlider6Ref;
extern RGBColor      gRedColor;
extern RGBColor      gBlueColor;
extern RGBColor      gBlackColor;

```

```
// ***** eventFilter

Boolean eventFilter(DialogRef dialogRef, EventRecord *eventStrucPtr, Sint16 *itemHit)
{
    Boolean    handledEvent;
    GrafPtr    oldPort;
    Point      mouseXY;
    ControlRef controlRef;

    handledEvent = false;

    if((eventStrucPtr->what == updateEvt) &&
        ((WindowRef) eventStrucPtr->message != GetDialogWindow(dialogRef)))
    {
        doUpdate(eventStrucPtr);
    }
    else if((eventStrucPtr->what == autoKey) && ((eventStrucPtr->modifiers & cmdKey) != 0))
    {
        handledEvent = true;
        return handledEvent;
    }
    else
    {
        GetPort(&oldPort);
        SetPortDialogPort(dialogRef);

        if(gGroupArrowsProgressActive)
        {
            if(eventStrucPtr->what == mouseDown)
            {
                mouseXY = eventStrucPtr->where;
                GlobalToLocal(&mouseXY);
                if(FindControl(mouseXY, GetDialogWindow(dialogRef), &controlRef))
                {
                    if(controlRef == gLittleArrowsControlRef)
                    {
                        TrackControl(controlRef, mouseXY, gArrowsActionFunctionUPP);
                        handledEvent = true;
                    }
                }
            }
        }
        else if(gSlidersActive)
        {
            if(eventStrucPtr->what == mouseDown)
            {
                mouseXY = eventStrucPtr->where;
                GlobalToLocal(&mouseXY);
                if(FindControl(mouseXY, GetDialogWindow(dialogRef), &controlRef))
                {
                    if(controlRef == gSlider1Ref || controlRef == gSlider2Ref)
                    {
                        TrackControl(controlRef, mouseXY, NULL);
                        doDrawSliderValues(dialogRef, controlRef);
                        handledEvent = true;
                    }
                }
            }
        }
    }
}
```

```

        else if(controlRef == gSlider3Ref || controlRef == gSlider4Ref)
        {
            TrackControl(controlRef,mouseXY,gSliderActionFunction1UPP);
            handledEvent = true;
        }
        else if(controlRef == gSlider5Ref || controlRef == gSlider6Ref)
        {
            TrackControl(controlRef,mouseXY,gSliderActionFunction2UPP);
            handledEvent = true;
        }
    }
}
}
else
{
    handledEvent = StdFilterProc(dialogRef,eventStrucPtr,itemHit);
}

SetPort(oldPort);
}

return handledEvent;
}

// ***** arrowsActionFunction *****
void arrowsActionFunction(ControlRef controlRef,SInt16 partCode)
{
    Str255 theString;
    SInt32 controlValue;

    if(partCode)
    {
        controlValue = GetControlValue(controlRef);

        switch(partCode)
        {
            case kControlUpButtonPart:
                controlValue += 32;
                if(controlValue > GetControlMaximum(controlRef))
                {
                    controlValue = GetControlMaximum(controlRef);
                    return;
                }
                break;

            case kControlDownButtonPart:
                controlValue -= 32;
                if(controlValue < GetControlMinimum(controlRef))
                {
                    controlValue = GetControlMinimum(controlRef);
                    return;
                }
                break;
        }
    }
}

```

```

        SetControlValue(controlRef,controlValue);

        NumToString((SInt32) controlValue,theString);
        doConcatPStrings(theString,"pK");
        SetControlData(gCacheSizeControlRef,kControlEntireControl,kControlStaticTextTextTag,
                        theString[0],&theString[1]);
        Draw1Control(gCacheSizeControlRef);
    }
}

// ***** sliderActionFunction1

void sliderActionFunction1(ControlRef controlRef,SInt16 partCode)
{
    SInt16    staticTextItem;
    Str255    theString;
    DialogRef dialogRef;

    NumToString((SInt32) GetControlValue(controlRef),theString);

    dialogRef = GetDialogFromWindow(GetControlOwner(controlRef));

    if(controlRef == gSlider3Ref)
        staticTextItem = iSlider3StaticText;
    else if(controlRef == gSlider4Ref)
        staticTextItem = iSlider4StaticText;

    GetDialogItemAsControl(dialogRef,staticTextItem,&controlRef);
    SetControlData(controlRef,kControlEntireControl,kControlStaticTextTextTag,theString[0],
                    &theString[1]);
    Draw1Control(controlRef);
}

// ***** sliderActionFunction2

void sliderActionFunction2(ControlRef controlRef,SInt16 partCode)
{
    SInt16 controlValue;
    Rect    theRect;

    controlValue = GetControlValue(controlRef);

    if(controlRef == gSlider5Ref)
    {
        gRedColor.red = 2 * controlValue;
        RGBForeColor(&gRedColor);
        SetRect(&theRect,220,177,236,193);
    }
    else if(controlRef == gSlider6Ref)
    {
        gBlueColor.blue = 2 * controlValue;
        RGBForeColor(&gBlueColor);
        SetRect(&theRect,220,198,236,214);
    }
}

```

```

    PaintRect(&theRect);
    RGBForeColor(&gBlackColor);
}

// *****
// SmallControls.c
// *****

// ..... includes

#include "Controls3.h"

// ***** doSmallControls

void doSmallControls(void)
{
    OSStatus      osError;
    Str255        pascalString;
    CFStringRef    stringRef;
    Rect          contentRect      = { 0, 0, 388, 175 };
    Rect          staticTextRect   = { 8, 20, 86, 144 };
    Rect          vertScrollBarRect = { -1, 164, 378, 175 };
    Rect          horizScrollBarRect = { 377, -1, 388, 165 };
    Rect          tabRect          = { 106, 20, 144, 144 };
    Rect          sliderRect       = { 164, 20, 182, 145 };
    Rect          radioButtonRect  = { 200, 23, 216, 144 };
    Rect          checkBoxRect     = { 220, 23, 236, 144 };
    Rect          editTextRect     = { 300, 26, 313, 139 };
    Rect          pushButtonRect   = { 338, 21, 356, 144 };
    WindowRef     windowRef;
    ControlFontStyleRec controlFontStyleStruc;
    ControlRef     controlRef;
    ControlSize    controlSize = kControlSizeSmall;
    ControlTabEntry tabArray[2];

    if(!(osError = CreateNewWindow(kFloatingWindowClass, kWindowStandardFloatingAttributes +
                                kWindowResizableAttribute, &contentRect,
                                &windowRef)))
    {
        ChangeWindowAttributes(windowRef, 0, kWindowCloseBoxAttribute);
        RepositionWindow(windowRef, NULL, kWindowAlertPositionOnMainScreen);
        SetThemeWindowBackground(windowRef, kThemeBrushDialogBackgroundActive, false);
        SetPortWindowPort(windowRef);
        UseThemeFont(kThemeSmallSystemFont, smSystemScript);
        ShowWindow(windowRef);
    }
    else
    {
        SysBeep(10);
        return;
    }

    GetIndString(pascalString, rSmallControlsString, 1);
    stringRef = CFStringCreateWithPascalString(NULL, pascalString, kCFStringEncodingMacRoman);

```

[illegible]



```

{
    SetControlData(controlRef,kControlEntireControl,kControlSizeTag,sizeof(controlSize),
                  &controlSize);
    SetControlFontStyle(controlRef,&controlFontStyleStruc);
}

// ..... pop-up menu button

if(controlRef = GetNewControl(cSmallPopup>windowRef))
    SetControlValue(controlRef,3);

// ..... edit text

if((osError = CreateEditTextControl(windowRef,&editTextRect,CFSTR("Small Edit Text"),false,
                                   false,&controlFontStyleStruc,&controlRef)) == noErr)
    SetKeyboardFocus(windowRef,controlRef,kControlFocusNextPart);

// ..... push button

if((osError = CreatePushButtonControl(windowRef,&pushButtonRect,CFSTR("Small Push Button"),
                                   &controlRef)) == noErr)
    SetControlFontStyle(controlRef,&controlFontStyleStruc);
}

// ***** doMouseDownSmallControls

void doMouseDownSmallControls(WindowRef windowRef,EventRecord *eventStrucPtr)
{
    SInt16      controlPartCode;
    ControlRef  controlRef = NULL;
    ControlKind controlKind;

    SetPortWindowPort(windowRef);
    GlobalToLocal(&eventStrucPtr->where);
    controlPartCode = FindControl(eventStrucPtr->where>windowRef,&controlRef);
    if(controlPartCode)
        TrackControl(controlRef,eventStrucPtr->where,NULL);

    if(controlRef)
    {
        GetControlKind(controlRef,&controlKind);
        if((controlKind.kind == kControlKindRadioButton) ||
           controlKind.kind == kControlKindCheckBox)
            SetControlValue(controlRef,!GetControlValue(controlRef));
    }
}

// *****

```

## Demonstration Program Controls3 Comments

When this program is run, the user should

- Choose items from the Demonstration menu to view and operate the various controls. (Note that the Small Controls item is only available when the program is run on Mac OS X.)
- On Mac OS 8/9, choose Show Balloons from the Help menu and note the information in the help balloons as the cursor is moved over the various controls.
- On Mac OS X, hover the cursor over the various controls and note the information in the help tags.
- Click in the Finder and then back in the window/dialog, noting control activation/deactivation.
- In the Bevel Buttons, Image Wells, Picture Controls, and Icon Controls window
  - Click in the various controls, noting in the window header the control part code returned by FindControl (or immediately by TrackControl in the case of the non-tracking icon controls).
  - Click in the various controls and then release the mouse button both within and outside the control, noting the control part code returned by TrackControl.
- In the Tab, Edit Text, and Clock Controls dialog
  - In the Edit Text Controls tab
    - Change the keyboard focus using the tab key and mouse clicks.
    - Enter a name, age, and password, noting the effect of the key filter function attached to the “Age” edit text control and the behavior of the “Password” edit text control.
    - Paste some text containing characters other than alphabetic characters, the space character, and the period character to the “Name” edit text control, noting that the edit text validation function strips out the “illegal” characters.
    - Note the cursor shape changes when the cursor is over the top two edit text controls.
    - Click the Extract push button to extract and display the contents of the edit text controls.
  - In the Clock Controls Tab
    - Change the keyboard focus using the tab key and mouse clicks.
    - Change the clock setting by typing and by using the integral little arrows.
    - Click the Extract push button to extract and display the clock settings.

- In the Group Boxes, Arrows, and Progress Bar dialog
  - Change the group box settings, the settings of the controls within the group boxes, and the (simulated) cache size setting controlled by the little arrows, and then click the Extract button to extract and display the settings of the various controls.
  - Click the disclosure triangle to show and hide the chasing arrows and indeterminate progress bar.
- In the Sliders and User Pane Functions dialog
  - Operate the sliders and note the difference in the appearance of the dragged indicator in the live scrolling and non-live scrolling variants of the sliders.
  - Note the appearance, in the activated and deactivated modes, of the two custom “controls” to the right of the two horizontal sliders. Also note that these controls are redrawn, in the appropriate mode, when an overlaying window or help balloon is removed (Mac OS 8/9).
- In the Text Boxes dialog, observe the auto scrolling variant and scroll the non-auto-scrolling variant.
- On Mac OS X, observe the small controls in the Small Controls floating window.

## Control3.h

### defines

Constants are established for the resource IDs and dialog item numbers associated with the various demonstrations.

### typedefs

A variable of type `BevelDocStruc` will be used to hold references to the various controls created in the Bevel Buttons, Image Wells, Picture Controls, and Icon Controls window.

## Control3.c

`Controls3.c` is simply the basic “engine” which supports the demonstration. There is nothing in this file which has not featured in previous demonstration programs.

### doMouseDown

In the `inContent` case, if a mouse-down occurs in the Bevel Buttons, Image Wells, Picture Controls, and Icon Controls window when it is the front window, the function `doBevelImagePictIconContent` is called.

In the `inGoAway` case, the Bevel Buttons, Image Wells, Picture Controls, and Icon Controls window is disposed of.

### **doUpdate**

If the Bevel Buttons, Image Wells, Picture Controls, and Icon Controls window is open, `UpdateControls` is called to redraw the controls in the appropriate mode.

### **doActivateWindow**

If the Bevel Buttons, Image Wells, Picture Controls, and Icon Controls window is open, and if it receives an activate event, `GetRootControl` is called to get a reference to the window's root control. The controls are then activated or deactivated en masse.

## **BevelImagePictIcon.c**

`BevelImagePictIcon.c` contains most of the source code relating to the Bevel Buttons, Image Wells, Picture Controls, and Icon Controls window.

### **doBevelImagePictIcon**

`doBevelImagePictIcon` opens a window, creates a relocatable block for a structure of type `BevelDocStruc` (to whose fields references to the various controls will be assigned) and stores the handle to this block in the window object.

The call to `GetNewCWindow` then creates the window. (Note that error handling here and in other areas of the demonstration is somewhat rudimentary in that the program simply terminates.) `NewHandle` creates the block for the variable of type `BevelDocStruc` and `SetWRefCon` stores the handle to the block as a reference constant in the window object.

Before `ShowWindow` is called to make the window visible, the function `doGetControls` is called to create the controls.

### **doGetControls**

`doGetControls` creates the controls from the various 'CNTL' resources.

At the first line, if the program is running on Mac OS 8/9, `CreateRootControl` is called to create a root control for the window. On Mac OS 8/9, the first control created must be always be the root control (which is implemented as a user pane). This call is not necessary on Mac OS X because, on Mac OS X, root controls are created automatically for windows which have at least one control.

A handle to the structure in which the reference to the control objects will be stored is then retrieved. The following calls to `GetNewControl` create a control object for each control, insert the reference to the object into the control list for the specified window and draw the control. At the same time, the reference to each control object is assigned to the appropriate field of the window's "document" structure.

At the next block, if the program is running on Mac OS X, `SetControlData` is called to make the first four bevel button's corners rounded. (Mac OS X bevel buttons have square corners by default.)

At the next block, `SetControlData` is called twice to cause the text in the specified bevel buttons to be placed above the graphic.

At the next block, `SetControlData` is called to cause the pop-up glyph in the specified bevel button to be centered.

At the next block, the font for the text in the specified bevel button is changed. The flags and font fields of a control font style structure are assigned constants so that the following call to `SetControlFontStyle` will set the font to the small emphasized system font.

The final line sets the value of the specified bevel button to 2, causing it to appear in the mixed state.

### **doBevelImagePictIconContent**

Recall that if a mouse-down occurs in the Bevel Buttons, Image Wells, Picture Controls, and Icon Controls window when it is the front window, `doBevelImagePictIconContent` is called to further handle the event.

At the first line a handle to the structure containing references to all the control objects is obtained.

The call to `GlobalToLocal` changes the coordinates at which the mouse-down occurred to the local coordinates required by the following call to `FindControl`. The constant representing the part code returned by `FindControl` is then drawn in the window header.

If the part code returned by `FindControl` is not `kControlNoPart` (0), meaning that an enabled control was under the mouse cursor at the time of the mouse-down, the if block executes. `TrackControl` takes control while the mouse button remains down, returning a part code when the button is released.

In the case of the first 10 specified controls (bevel buttons), the control part code returned by `TrackControl` is simply drawn in the window header.

The next four controls are bevel buttons with menus. In these cases, if the part code returned indicates that the mouse button was released while the cursor was within the menu, `GetBevelButtonMenuValue` is called to get the menu item number. The part code and menu item number are then drawn in the window header. If the cursor was not in the menu when the mouse button was released, the part code returned by `TrackControl` is drawn in the window header.

The 10th, 11th, and 12th bevel buttons have toggle behavior. With some assistance from the application, they behave like radio buttons. If the control in which the mouse-down occurred was one of these bevel buttons, and if the cursor was still within the control when the mouse button was released, `SetControlValue` is called to set the three controls to the unchecked state, following which the selected control is set to the checked state. Either way, the part code returned by `TrackControl` is drawn in the window header.

The 18th bevel button is used to demonstrate bevel button graphic alignments using a single bevel button. A mouse-down within this button causes the function `doGraphicAlignment` to be called.

The 19th bevel button is used to demonstrate bevel button text alignments using a single bevel button. A mouse-down within this button causes the function `doTextAlignment` to be called.

The 20th bevel button is used to demonstrate text offsetting using a single bevel button. A mouse-down within this button causes the function `doTextOffset` to be called.

The 21st bevel button is used to demonstrate bevel button text placement in relation to the bevel button's graphic using a single bevel button. A mouse-down within this button causes the function `doTextPlacement` to be called.

Finally, if the mouse-down was in an image well, picture control, or icon control, and except for the non-tracking picture and icon control variants, the part code returned by `TrackControl` is drawn in the window header.

### **doDrawPartCode**

`doDrawPartCode` takes part codes and menu item numbers and assembles them into descriptive strings for drawing in the window header. The constants used are stored in 'STR#' resources, and are retrieved using `GetIndString`. In the final two lines, `Draw1Control` is called to redraw the window header control (in effect erasing the current text drawn within the window header area) and `doDrawMessage` is called to draw the assembled string.

### **doGraphicAlignment**

`doGraphicAlignment` is called to demonstrate bevel button graphic alignment using the helper function `SetBevelButtonGraphicAlignment`, which facilitates finer adjustment of graphic placement than using `SetControlData` with the `kControlBevelButtonGraphicAlignTag` control data tag constant. Each time around the outer for loop, the alignment constant is changed. In the inner for loop, `SetBevelButtonGraphicAlignment` is called 53 times, with the two offset parameters incremented and `Draw1Control` called at each call. The alignment constant used during each pass through the outer for loop is drawn in the window header.

### doTextAlignment

`doTextAlignment` is called to demonstrate the effect of the bevel button text alignment constants using the helper function `SetBevelButtonTextAlignment`, which facilitates finer adjustment of text placement that using `SetControlData` with the `kControlBevelButtonGraphicAlignTag` control data tag constant. Each time around the outer for loop, the alignment constant is changed. In the inner for loop, `SetBevelButtonTextAlignment` is called 41 times, with the offset parameter incremented and `Draw1Control` called at each call. The alignment constant used during each pass through the outer for loop is drawn in the window header.

### doTextOffset

`doTextOffset` is called to demonstrate text offsetting from the left and the right within a bevel button. For the purposes of the demonstration, two animations involving incrementing offsets values are used. Prior to first animation, `SetControlData` is called with the `kControlBevelButtonTextOffsetTag` tag to align the text on the left. Prior to second animation, `SetControlData` is called with the `kControlBevelButtonTextOffsetTag` tag to align the text on the right. Within the for loops, `SetControlData` is called with the `kControlBevelButtonTextOffsetTag` tag to offset the text from the left or right by the specified number of pixels, and `Draw1Control` redraws the control.

### doTextPlacement

`doTextPlacement` is called to demonstrate the effect of the bevel button text placement constants. Within a for loop which increments the text placement constant, `SetBevelButtonTextPlacement` is called and `Draw1Control` redraws the control.

### doDrawMessage and doDrawLegends

`doDrawMessage` and `doDrawLegends` are incidental to the demonstration. Both functions draw text in the window in either black or gray depending on whether the window is currently in front or in the background.

## TabEditClock.c

`TabEditClock.c` creates a movable modal dialog in which is demonstrated a tab control, edit text controls and clock controls. A numeric key filter function is attached to the second edit text control. The third edit text control is for password input. The controls displayed by each tab are embedded in user panes.

The `kDialogFlagsUsesControlHierarchy` flag is set in the 'dlgx' resources for all dialogs used in the demonstration. Recall that this means that the Dialog Manager creates a root control in the dialog and establishes an embedding hierarchy, that all dialog items automatically become controls, and that the Dialog Manager uses `AutoEmbedControl` to position dialog items in an embedding hierarchy based on both visual containment and their item list number.



The dialog item list used by the dialog created by `TabEditClock.c` is shown in the following, in which the indentation represents the embedding hierarchy:

1. OK push button primitive.
2. Tab control (`kTabControlLargeProc` variant).
  - Visually contains the two user panes (items 3 and 12) and thus automatically embeds those items.
  - 3. User pane control with `kControlSupportsEmbedding` feature bit set (initial value set to 2).
    - Visually contains items 4 to 11 and thus automatically embeds those items.
    - 4. Static text primitive "Name:".
    - 5. Edit text primitive.
    - 6. Static text primitive "Age:".
    - 7. Edit text primitive.
    - 8. Static text primitive "Password:".
    - 9. Edit text control (`kControlEditTextPasswordProc` variant).
    - 10. Extract push button primitive.
    - 11. Image well control.
  - 12. User pane control with `kControlSupportsEmbedding` feature bit set (initial value set to 2).
    - Visually contains items 13 to 20 and thus automatically embeds those items.
    - 13. Static text primitive "Hours, Mins, Secs:".
    - 14. Clock control (`kControlClockTimeSecondsProc` variant).
    - 15. Static text primitive "Date, Month, Year:".
    - 16. Clock control (`kControlClockDateProc` variant).
    - 17. Static text primitive "Month, Year:".
    - 18. Clock control (`kControlClockMonthYearProc` variant).
    - 19. Extract push button primitive.
    - 20. Image well control.
21. Clock control (`kControlClockTimeSecondsProc` variant, live, display only.)
22. Group box (`kControlGroupBoxSecondaryTextTitleProc` variant).
  - Visually contains item 23 and thus automatically embeds that item:
  - 23. Static text primitive.

### doTabEditClock

`doTabEditClock` creates the dialog, calls `ModalDialog` to handle events in the dialog, and disposes of the dialog when the user hits the OK push button.

As is always required when a dialog is to be displayed, the front window (if one exists) is explicitly deactivated.

The call to `GetNewDialog` creates the dialog. The call to `SetWTitle` sets the window's title so as to force an association with the 'hrct' resource containing the help balloons for the Edit Text Control tab. (Later calls to `SetWTitle` in this function are used for similar purposes.)

`SetDialogDefaultItem` tells the Dialog Manager which is the default push button item, to alias the Return and Enter keys to that item, and to draw the default ring around that item (Mac OS 8/9) or make it pulsing blue (Mac OS X). `SetDialogTracksCursor` will cause the Dialog Manager to change the cursor shape to the I-Beam cursor whenever the cursor is over an edit text item specified in the 'DITL' as an edit text primitive.

The first call to `GetDialogItemAsControl` gets a reference to the user pane used for the clocks tab. `HideControls` hides this user pane and all the controls automatically embedded within it.

At the next block, `SetControlData` is called with the `kControlEditTextTextTag` tag to assign some text to the first edit text control. The fields of an edit text selection structure are then assigned values which will cause the following call to `SetControlData` to select the entire edit text control.

The next block creates universal procedure pointers for event filter, key filter, and edit text validator callback functions. (The event filter function is defined in the source code file `Callbacks.c`.) `SetControlData` is then called with the `kControlEditTextValidationProcTag` tag to attach the edit text validation function to the first edit text control. `SetControlData` is then called again with the `kControlEditTextKeyFilterTag` tag to attach the key filter function to the second edit text control.

With those preliminaries attended to, `ShowWindow` is called to display the window, following which the `ModalDialog` loop is entered. The loop will execute until the user hits the OK push button. Note that the previously created UPP is passed in the `filterProc` parameter of `ModalDialog`.

When a mouse-down event occurs in an enabled item, `ModalDialog` returns the item number of the item hit. If the item hit was the tab item, `GetDialogItemAsControl` is called to get a reference to the tab control and `GetControlValue` is called to determine which of the two tabs was hit. If the tab hit was the Edit Text Controls tab, the Clock Controls user pane is hidden, the Edit Text Controls user pane is shown, and the keyboard focus is set to the first edit text control. If the tab hit was the Clock Controls tab, the Edit Text Controls user pane is hidden, the Clock Controls user pane is shown, and the keyboard focus is set to the first clock control.

If the item hit was the Extract push button in the Edit Text Controls pane, the image well control is redrawn to erase any previous text and a function is called to extract and display the contents of the edit text controls.

If the item hit was the Extract push button in the Clock Controls pane, the image well control is redrawn to erase any previous text and a function is called to extract and display the contents of the clock controls.

When the user hits the OK button, `DisposeDialog` closes the dialog and disposes of the associated memory, and the universal procedure pointers associated with the event filter function and key filter function are disposed of.

### **doExtractEditText**

`doExtractEditText` extracts the text from the edit text controls and draws it in the image well area. In the case of the Password edit text control, the text extracted is the actual password typed, not the bullet text.

In the case of the first two edit text controls, `GetDialogItem` is used to get the handle to the `hText` field of the `TERec` structure used by the item. This is where the characters are located. (Exactly what is returned in the `iHandle` field of a `GetDialogItem` call depends on the item type.) `GetDialogItemText` then copies these characters to a variable of type `Str255`.

In the case of the third (password) edit text control, `GetDialogItemAsControl` gets a reference to the control. `GetControlDataSize` is then called with the `kControlEditTextTextTag` tag to get the number of characters and `GetControlData` is called with the `kControlEditTextPasswordTag` to get the clear password text from the control.

### **doExtractDateTime**

`doExtractDateTime` gets the settings in the three clock controls into a long date structure, extracts the content of the relevant fields of that structure, and draws that content in the image well area.

For each clock, `GetControlData` is called with the `kControlClockLongDateTag` tag to get the information into a long date structure. The rest of the code simply converts the values in the relevant fields of this structure to strings, which are concatenated with other identifying strings prior to being drawn in the image well.

### **numericFilter**

`numericFilter` is the key filter function attached to the second edit text control.

The character code and modifiers parameters passed to this function by the control are first examined to determine whether the character code represents the numeric characters between 0 and 9 inclusive or whether the Command key was down. If either of these conditions is true, the function returns `kControlKeyFilterPassKey`. This means that, if the character is between 0 and 9 inclusive, it will be accepted. It also means that, if the Command key was down, non-numeric characters will be accepted as well. This latter is necessary to ensure that the user can edit the text in the edit text control using the usual Edit menu Command-key equivalents.

If a return does not occur at that point, the character code is further examined to determine whether it represents one of the arrow keys, the backspace key or the delete key. If so, `kControlKeyFilterPassKey` is returned. If not, the system alert sound is played and `kControlKeyFilterBlockKey` is returned, meaning that the character is to be rejected.

### **editTextValidator**

`editTextValidator` is the edit text validation callback function attached to the first edit text control.

The call to `GetControlData` gets the text to be examined from the control into the variable `oldText`. The next block sets the length byte in `oldText` to the actual number of characters in the text, limited to 255 characters. The for loop then examines each character and, if it is an

alphabetic character, the space character, or the period character, inserts it into the `newText` variable and increments a variable which is eventually used to set the length byte of `newText`. When the if loop exits, the length byte is set and `SetControlData` is called to put the replacement text into the control. Finally, `Draw1Control` redraws the control.

## GroupArrowsProgress.c

`GroupArrowsProgress.c` creates a movable modal dialog in which is demonstrated a checkbox group box, a pop-up group box, little arrows, a disclosure triangle, chasing arrows, and an indeterminate progress bar.

The checkbox group box contains a static text item and three radio buttons. The radio buttons are embedded in a radio group. The pop-up group box contains two user panes. Embedded in each user pane are a checkbox and a radio group. Embedded in each radio group are two radio buttons.

The dialog item list used by the dialog created by `GroupArrowsProgress.c` is shown in the following, in which the indentation represents the embedding hierarchy:

1. Push button primitive.
2. Group box control (kControlGroupBoxCheckboxProc variant).
  3. Radio group control.
    4. Radio button primitive.
    5. Radio button primitive.
    6. Radio button primitive.
  7. Checkbox primitive.
8. Group box control(kControlGroupBoxPopupButtonProc variant).
  9. User pane control with kControlSupportsEmbedding feature bit set (initial value set to 2).
    10. Radio group control
      11. Radio button primitive.
      12. Radio button primitive.
    13. Checkbox primitive.
    14. Static text primitive.
  15. User pane control with kControlSupportsEmbedding feature bit set (initial value set to 2).
    16. Radio group control
      17. Radio button primitive.
      18. Radio button primitive.
    19. Checkbox primitive.
    20. Static text primitive.
21. Group box control (kControlGroupBoxSecondaryTextTitleProc variant).
  22. Static text primitive.
23. Group box control (kControlGroupBoxSecondaryTextTitleProc variant).
  24. Static text primitive.
  25. Placard control.
    26. Static text primitive.
  27. Little arrows control.
28. Extract push button primitive.
29. Image well
30. Separator line
31. Disclosure triangle (kControlTriangleProc variant).
32. Static text primitive.

A second dialog item list resource, containing a chasing arrows control and a progress bar control, is appended to the dialog when the disclosure triangle is clicked.

### **doGroupArrowsProgress**

`doGroupArrowsProgress` creates the dialog, calls `ModalDialog` to handle events until the user hits the OK push button, and then disposes of the dialog.

At the first two lines, if the Bevel Buttons, Image Wells, Picture Controls, and Icon Controls window is open, it is explicitly deactivated.

The call to `GetNewDialog` creates the dialog and `SetDialogDefaultItem` establishes the OK push button as the default push button.

The next two lines create universal procedure pointers for the application-defined event filter (callback) function and an application-defined action function for the little arrows control. (The event filter function is in the source code file `Callbacks.c.`)

The next block sets the initial value of the checkbox group box to 1 (checked).

The little arrows are used to set a (simulated) cache size, which is displayed in a static text item overlaid on a placard item. The little arrows initial value is set in the 'CNTL' resource to 96. The first three lines of the next block extract this value, convert it to a string and append the character "K". `SetControlData` is then called with the `kControlStaticTextTextTag` to set this string in the static text item.

The second user pane in the pop-up group box is then hidden before the call to `ShowWindow`, following which the `ModalDialog` loop is entered. Note that the UPP associated with the application-defined event filter function is passed in the `filterProc` parameter of `ModalDialog`.

If `ModalDialog` reports that the item hit was the checkbox group box's checkbox or the pop-up group box's pop-up menu, functions are called to further handle the hit.

If the item hit was one of the checkboxes within the pop-up group box, the control's control value is set so that the control is checked if it was unchecked, or unchecked if it was checked.

If the item hit was the disclosure triangle, a function is called to further handle the hit.

If the item hit was the Extract push button, `Draw1Control` is called to redraw the image well, thus erasing any previous text in the well, and a function is called to extract the control settings and draw them in the image well area.

Note that hits on the radio buttons will be handled automatically by the radio group controls in which they are embedded. The radio group control will set the new control values according to which radio button is hit, and will change the checked/unchecked appearance of the radio buttons to match.

Note also that mouse-down events in the little arrows are detected and handled in the event filter function. (See the source code file `Callbacks.c.`)

When the OK button is hit, the loop exits, `DisposeDialog` closes the dialog and disposes of the associated memory, and the two previously created universal procedure pointers are disposed of. In addition, the global variable that flags that the dialog was open is set to false.

### **doCheckBoxGroupBox**

`doCheckBoxGroupBox` further handles a hit in the checkbox group box's checkbox.

The first three lines flip the control's value; that is, if the control's value was 1 (checked), it is set to 0 (unchecked), and vice versa.

If the new value of the control is 0 (unchecked), the radio group and checkbox within the group box are deactivated. Since the radio buttons are embedded in the radio group, they will also be deactivated when the radio group is deactivated.

If the new value of the control is 1 (checked), the radio group and checkbox within the group box are activated. Since the radio buttons are embedded in the radio group, they will also be activated when the radio group is activated.

### **doPopupGroupBox**

`doPopupGroupBox` further handles a hit in the pop-up group box's pop-up menu button.

The first two lines get the control's value, which represents the menu item chosen. Depending on the item chosen, the appropriate user panes are hidden or shown, thus hiding or showing all controls embedded in each user pane.

### **doChasingAndProgress**

`doChasingAndProgress` further handles a hit in the disclosure triangle.

The first three lines flip the control's value; that is, if the control's value was 1 (expanded), it is set to 0 (collapsed), and vice versa.

If the new control value is 1 (expanded), `GetResource` is called to load the item list resource containing the chasing arrows and progress bar items. `AppendDITL` is then called to append these items to the end of the dialog's item list. The constant passed in the third parameter of this call causes the dialog to be expanded downwards to accommodate the new items. `SetControlData` is then called with the `kControlProgressBarIndeterminateTag` tag to make the progress bar an indeterminate progress bar.

Not previously mentioned is the fact that the appended 'DITL' resource contains a static text item, with no text, the function of which is simply to expand the dialog further downwards to accommodate a move of the OK push button. The call to `MoveControl` moves the OK push button to a position below the chasing arrows and progress bar.

Finally, `SetControlData` is called with the `kControlStaticTextTextTag` tag to change the text in the static text control adjacent to the disclosure triangle. `Draw1Control` redraws the control to display the changed text.

If the new disclosure triangle control value is 0 (collapsed), the OK button is moved back to its previous location, `SizeWindow` is called to resize the window to its previous size, `SetControlData` is called with the `kControlStaticTextTextTag` tag to change the text in the static text control adjacent to the disclosure triangle, and `Draw1Control` redraws the control to display the changed text.

### **doExtractCurrentStatus**

`doExtractCurrentStatus` is called when the Extract push button is hit. It simply extracts the values of the various controls, builds up strings based on those values, and draws those strings in the image well area.

Note in the second last block that the value of the little arrows control represents the current (simulated) cache size. The little arrows control value is set within the action function `arrowsActionFunction` in the source code file `Callbacks.c`.

## **Sliders.c**

`Sliders.c` creates a movable modal dialog in which is demonstrated various slider control variants and two simple user pane functions.

### **doSliderUserPane**

`doSliderUserPane` creates the dialog, calls `ModalDialog` to handle events until the user hits the OK push button, and then disposes of the dialog.

At the first two lines, if the Bevel Buttons, Image Wells, Picture Controls, and Icon Controls window is open, it is explicitly deactivated.

The call to `GetNewDialog` creates the dialog and `SetDialogDefaultItem` establishes the OK push button as the default push button.

The next three lines create universal procedure pointers for the application-defined event filter (callback) function and two application-defined action functions for the live-feedback slider variants, one for the two at top right of the dialog and one for the two horizontal sliders. (The event filter function and the action functions are in the source code file `Callbacks.c`.)

The next two blocks creates universal procedure pointers for two user pane functions (one a draw function and one an activate function), and attach these functions to a user pane located immediately to the right of the two horizontal sliders.



The next block assigns references to the first four sliders to global variables and call a function to draw the respective control values in static text items located immediately below the sliders.

The following four lines assign references to the horizontal sliders to global variables and assign a value based on the current slider control values to the red and blue fields of two global variables of type `RGBColor`.

The call to `ShowWindow` makes the dialog visible before the `ModalDialog` loop is entered. This loop executes until the OK button is hit, at which time `DisposeDialog` is called to remove the dialog and dispose of its associated memory, the previously created universal procedure pointers are disposed of, and the global variable which flags that the Sliders dialog is open is assigned false.

### **doDrawSliderValues**

`doDrawSliderValue` is called by `doSliderUserPane` to draw the initial control values of the four top sliders in the static text controls immediately below the sliders.

The first line gets the control's value and converts it to a string. The next block determines, on the basis of the received control reference, which is the target static text item. `SetControlData` is then called with the `kControlStaticTextTextTag` tag to set the text, and `Draw1Control` redraws the static text control.

As will be seen, this function is also called from within the event filter function when a mouse-down has been detected within the two non-live-scrolling sliders.

### **userPaneDrawFunction**

`userPaneDrawFunction` will be called whenever an update event is received. This will occur when the dialog is opened and, subsequently, when an overlaying window or help balloon is removed from the area occupied by the user pane (to the immediate right of the horizontal sliders).

The two calls to `DrawThemePlacard` draw two Appearance Manager placard primitives to the right of the horizontal sliders. The global variable `gDrawActivated` determines whether the primitive is drawn with an activated or deactivated appearance.

If the global variable `gDrawActivated` indicates that the interior of the placard should be drawn, the foreground color for each interior is set to that stored in global variables and `PaintRect` is called to paint the interior in that color. (As will be seen, the value stored in these global variables is changed by the action function called while the mouse button remains down in the slider's indicators.)

If `gDrawActivated` indicates that the interior of the placard should be displayed with a deactivated appearance, the interior is left as drawn by `DrawThemePlacard`.

### **userPaneActivateFunction**

The `kControlWantsActivate` feature bit is set in the user pane on creation, that is, the control's minimum value in the 'CNTL' resource is set to 16. This ensures that this function will be called when the dialog receives activate events.

Depending on whether the dialog is about to be activated or deactivated, the global variable `gDrawActivated` is set to true or false. As has been seen, this global variable controls the way in which the placard primitive and its interior is drawn.

## **TextBox.c**

`doTextBox` is called when the user chooses Text Boxes from the Demonstration menu. It opens a movable modal dialog containing standard and scrolling text box controls.

## **Callbacks.c**

`Callbacks.c` contains the event filter (callback) function used by all movable modal dialogs and three action functions, one for the little arrows, one for the vertical live-feedback sliders, and one for the horizontal live-feedback sliders.

### **eventFilter**

The event filter function `eventFilter` is identical to the event filter function introduced in Chapter 8 except that it intercepts mouse-down events in the little arrows and sliders and informs `ModalDialog` that it has handled those events.

After the call to `SetPortDialogPort`, if the Group Boxes, Arrows, and Progress Bar dialog is currently open, and if the event is a mouse-down event, the location of the mouse-down is extracted from the `where` field of the event structure and converted to the local coordinates required by the following call to `FindControl`. If `FindControl` determines that there is an enabled control under the mouse cursor, and if that control is the little arrows control, `TrackControl` is called to handle all user interaction while the mouse button remains down. While the mouse button remains down, `TrackControl` continually calls the action function pointed to by the UPP passed in the third parameter. When the mouse button is released, the function exits with true being returned to `ModalDialog`.

If, on the other hand, the Sliders and User Pane Functions dialog is open, and if the event is a mouse-down event, and if `FindControl` reports an enabled control, and if that control is one of the two non-live-feedback sliders, `TrackControl` is called to handle all user interaction while the mouse button remains down. When the mouse button is released, the function `doDrawSliderValues` is called to draw the new control value in the static text item below the slider. Once again, the function then exits with true being returned to `ModalDialog`.

If the mouse-down was in one of the two live-feedback sliders at the top right of the dialog, `TrackControl1` is called with a UPP to the first slider action function passed in the third parameter.

If the mouse-down was in one of the two horizontal live-feedback sliders, `TrackControl1` is called with a UPP to the second slider action function passed in the third parameter.

### **arrowsActionFunction**

`arrowsActionFunction` is the action function for the little arrows. It is called continually by `TrackControl1` while the mouse button remains down.

If the mouse cursor is still within the control, `GetControlValue` is called to get the current control value. The function then switches according to the part code. If the cursor is in the top arrow, the control's value is increased by 32 unless this would cause the value to exceed the control's maximum value (set in the 'CNTL' resource to 7680). If the cursor is in the bottom arrow, the control's value is decreased by 32 unless this would cause the value to be lower than the control's minimum value (set in the 'CNTL' resource to 96).

If the control's value was increased or decreased within the switch, `SetControlValue` is called to set the new control value, and the final block sets the new text for the Cache size static text item and re-draws the item.

### **sliderActionFunction1**

`sliderActionFunction1` is the action function for the live-feedback sliders at the top right of the dialog. It is called continually by `TrackControl1` while the mouse button remains down.

`GetControlValue` gets the control's current value and `NumToString` converts it to a string for display. The next line gets the reference to the control's owning window required by the call to `GetDialogItemAsControl1`. The if block determines which of the two sliders the mouse is down in. The last two lines set the text in the appropriate static text control and redraw the control.

### **sliderActionFunction2**

`sliderActionFunction3` is the action function for the horizontal live-feedback sliders. It is called continually by `TrackControl1` while the mouse button remains down.

`GetControlValue` gets the control's current value. If the slider is the top horizontal slider, the red field of the `RGBColor` global variable `gRedColor` is assigned a new value based on the control's current value, and the local `Rect` variable is assigned coordinates based on the placard at the right of the slider. If the slider is the bottom horizontal slider, the blue field of the `RGBColor` global variable `gBlueColor` is assigned a new value based on the control's current value, and the local `Rect` variable is assigned coordinates based on the placard at the right of the slider.

Finally, `PaintRect` is called to paint the interior area of the relevant image well in the new color.

## SmallControls.c

### doSmallControls

`doSmallControls` is called when the user chooses the Small Controls item in the Demonstration menu (Mac OS X only). It opens a floating window in which those controls with small versions are displayed.

Note that

- A call to `SetControlData` with the `kControlSizeTag` tag is required to make the scroll bars small.
- The value passed in the third parameter of the `CreateTabsControl` call makes the tab control small.
- A call to `SetControlData` with the `kControlSizeTag` tag is required to make the slider control small.
- A call to `SetControlData` with the `kControlSizeTag` tag is required to make the radio button and checkbox controls small. In addition, a call to `SetControlFontStyle` is required to make the title small.
- The only way to create a pop-up menu button with both the menu and the title small is to create the control from a 'CNTL' resource, specifying the “use window font” variant. (Note that the window font is set to the small system font.)
- The edit text control is made small by making the control’s rectangle 12 pixels high and changing the font to the small system font by passing the address of a `ControlFontStyleRec` structure in the sixth parameter of the `CreateEditTextControl` call.
- The push button is made small by making the control’s rectangle 17 pixels high and calling `SetControlFontStyle` to make the title small.

## IN THIS CHAPTER

- The Carbon Printing Manager 796
- Printer Drivers 797
- Page and Paper Rectangles 797
- Page Setup Dialogs and Print Dialogs 798
- Printing Sessions—The PMPrintSession Object 800
- The PMPageFormat and PMPrintSettings Objects 800
- Printing a Document 805
- Text on the Screen and the Printed Page 808
- Customizing the Page Setup and Print Dialogs 809
- Displaying Page Setup and Print Dialogs As Window-Modal (Sheet) Dialogs 811
- Saving and Retrieving a Page Format Object 811
- Printing from the Finder—Mac OS 8/9 811
- Main Carbon Printing Manager Constants, Data Types and Functions 812
- Demonstration Program CarbonPrinting Listing 815
- Demonstration Program CarbonPrinting Comments 837

## The Carbon Printing Manager

The inclusion of the word “Carbon” in the title of this chapter is quite deliberate, reflecting the fact that, in Carbon, the original **Printing Manager** has been replaced by the new **Carbon Printing Manager**. The Carbon Printing Manager provides a bridge between the fundamentally different Mac OS X and Mac OS 8/9 printing architectures.

When running on Mac OS 8/9, Carbon applications use Classic printer drivers and, generally speaking, Carbon Printing Manager functions simply call through to their original Printing Manager counterparts. When running on Mac OS X, Carbon applications use the new printing architecture and print through different drivers.

The most significant difference between the old Printing Manager and the Carbon Printing Manager is that all data structures are now opaque. Accessor functions are provided to access the information in these objects.

### Printing Sessions

In Carbon Printing Manager parlance, an individual printing task is known as a **session**. Carbon applications running on Mac OS X can initiate multiple simultaneous printing sessions, each of which is completely independent of the other. On Mac OS 8/9, printing sessions are also supported, but with the limitation that an application can only ever have one printing session running.

### Categories of Carbon Printing Manager Functions

The Carbon Printing Manager API comprises

- Session functions
- Non-session functions
- Universal functions

The non-session functions do not support simultaneous printing sessions and inherit many of the limitations of the original Printing Manager. For this reason, Apple strongly recommends that the session functions be used instead. (Session and non-session functions must not be mixed within an application.) Accordingly, this chapter addresses the session and universal functions only.



## Printer Drivers

Each type of printer has its own **printer driver**. Printer drivers performs the actual printing, translating system software drawing functions as required and send the translated instructions and data to the printer. On Mac OS 8/9, printer drivers are stored in **printer resource files**.

The **current printer** (on Mac OS 8/9, the printer selected by the user in the Chooser) is the printer driver that actually implements the functions defined by the Carbon Printing Manager.

## Types and Characteristics of Printer Drivers

In general, there are two types of printer driver:

- QuickDraw printer drivers
- PostScript printer drivers

### QuickDraw Printers

QuickDraw printers use QuickDraw to render images, which are then sent to the printer as bitmaps or pixel maps. Since they rely on the rendering capabilities of the Macintosh computer, QuickDraw printers are not required to have any intelligent rendering capabilities. Instead, they simply accept instructions from the printer driver to place dots on the page in specified places.

### PostScript Printers

Unlike QuickDraw printers, PostScript printers have their own rendering capabilities. Instead of rendering the entire page on the Macintosh computer and sending all the pixels to the printer, PostScript printer drivers convert QuickDraw operations into equivalent PostScript operations and send the resulting drawing commands directly to the printer. The printer then renders the images by interpreting these commands. In this way, image processing is offloaded from the computer.

## Background Printing and Spool Files

Most printer drivers allow users to specify **background printing**, which allows a user to work with an application while documents are printing in the background. On Mac OS 8/9, these printer drivers send printing data to a spool file in the PrintMonitor Documents folder in the System Folder.

## Page and Paper Rectangles

Because of an individual printer's mechanical limitations, the printable area of a page is ordinarily less than the physical size of the paper.



## Page Rectangle

The **page rectangle** represents the printable area. As shown in Fig 1, the upper-left coordinates of the page rectangle are always (0,0) and the lower-right coordinates represent the maximum printable area height and width for a given printer.

## Paper Rectangle

The **paper rectangle** (see Fig 1) represents the physical paper size expressed in the same coordinate system as the page rectangle. The upper left coordinates of the paper rectangle are thus usually negative.

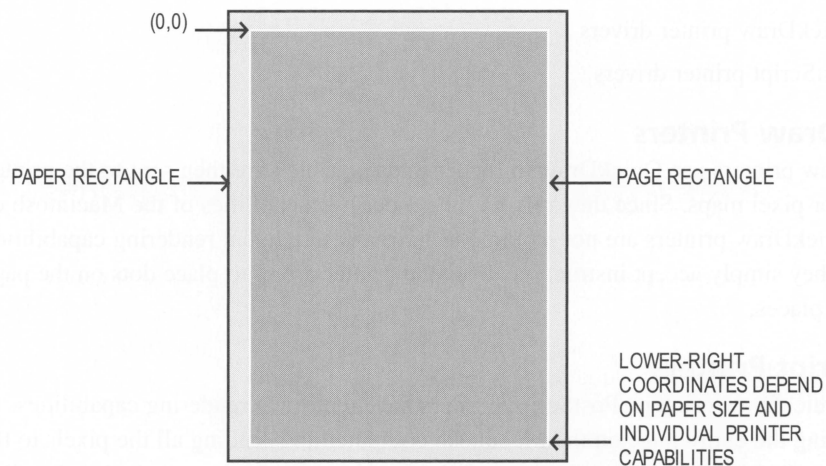


FIG 1 - PAGE AND PAPER RECTANGLES

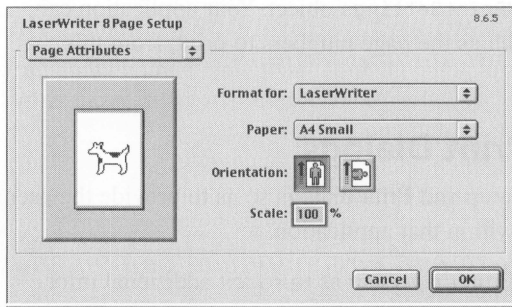
## Page Setup Dialogs and Print Dialogs

### Page Setup Dialog

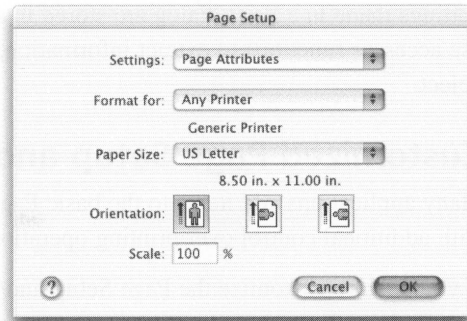
In response to the user choosing the Page Setup... item from the File menu, your application should display the **Page Setup dialog**. For Mac OS 8/9, each printer driver defines its own Page Setup dialog. For Mac OS X, printer manufacturers can extend the standard Page Setup dialog with options specific to their printer. Fig 2 shows the Page Setup dialog.

### Displaying the Page Setup Dialog and Accessing Settings

`PMSessionPageSetupDialog` is used to display the Page Setup dialog. This function handles all user interaction until the user clicks the OK or Cancel button.



LASERWRITER 8 PRINTER — MAC OS 8/9



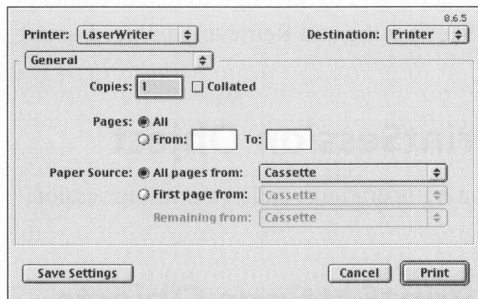
MAC OS X

FIG 2 -PAGE SETUP DIALOG

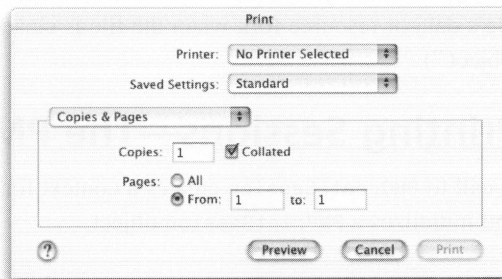
Settings made in a Page Setup dialog are stored in a `PMPageFormat` object. Your application can use accessor functions to extract information, such as orientation and scaling settings, from this object.

## Print Dialog

In response to the user choosing the **Print...** item in the File menu, your application should display the **Print dialog**. For Mac OS 8/9, each printer driver defines its own Print dialog. For Mac OS X, printer manufacturers can extend the standard Print dialog with options specific to their printer. Fig 3 shows the Print dialog.



LASERWRITER 8 PRINTER — MAC OS 8/9



MAC OS X

FIG 3 - PRINT DIALOG

## Displaying the Print Dialog and Accessing Settings

`PMSessionPrintDialog` is used to display the Print dialog. This function handles all user interaction until the user clicks the Print or Cancel button.

Settings made in a Print dialog are stored in a `PMPrintSettings` object. Your application can use accessor functions to extract information, such as the page numbers to print, from this object.

## Customized Page Setup and Print Dialogs

Many applications add items to the basic Page Setup and Print dialogs so as to provide the user with additional control over printing operations within that application.

If you wish to customize the Page Setup and/or Print dialogs so as to solicit additional information from the user, one option is to use what is sometimes referred to as the `AppendDITL` method. This requires that you provide an **initialization function**, an **item evaluation function** and, possibly, an event filter function. A universal procedure pointer to the initialization function is passed as a parameter in the functions `PMSessionPageSetupDialogMain` and `PMSessionPrintDialogMain`, which are used to display, respectively, customized Page Setup and customized Print dialogs. (See “Customizing the Page Setup and Print Dialogs.”)

## Preserving the User’s Printing Settings

The only information you should preserve each time the user prints the document should be that obtained via the Page Setup dialog. The information supplied by the user through the Print dialog should pertain to the document only while the document prints, and you should not reuse this information if the user prints the document again.

You can preserve the information obtained via the Page Setup dialog by associating the `PMPageFormat` object with the relevant document’s window and by saving it to that document file’s data or resource fork when the file is closed. (See “Saving and Retrieving a Page Format Object.”)

## Printing Sessions—The `PMPrintSession` Object

A call to `PMCreateSession` creates a context for printing operations, called a printing session, and initializes a `PMPrintSession` object.

## The `PMPageFormat` and `PMPrintSettings` Objects

### `PMPageFormat` Object

The `PMPageFormat` object stores information about how the pages of a document should be printed, for example, on what paper size and in what orientation (landscape or portrait).

You use the function `PMCreatePageFormat` to create an instance of this opaque object. `PMCreatePageFormat` returns a reference to the object, which is created empty of settings.

When your application displays a Page Setup dialog, and the user clicks the OK button to dismiss the dialog, the Carbon Printing Manager saves the settings in the `PMPageFormat` object.

As will be seen, `PMPageFormat` objects are extensible, meaning that your application can store additional data in them and that your application should never assume that they are of a fixed size.

## Accessor Functions

The following describes accessor functions you can use to obtain information contained within `PMPageFormat` objects.

<i>Function</i>	<i>Description</i>
<code>PMGetAdjustedPaperRect</code>	<p>Gets the paper size.</p> <p>On return, the <code>paperRect</code> parameter contains a rectangle describing the size of the paper after scaling, application drawing resolution and orientation settings are applied. The <code>paperRect</code> parameter is of type <code>PMRect</code>:</p> <pre>struct PMRect {     double top;     double left;     double right;     double bottom; }</pre> <p>The size returned is in your application drawing resolution, which you can obtain by calling <code>PMGetResolution</code>.</p>
<code>PMGetAdjustedPageRect</code>	<p>Gets the page size.</p> <p>On return, the <code>pageRect</code> parameter contains a rectangle describing the size of the page after scaling, application drawing resolution, and orientation settings are applied. The <code>pageRect</code> parameter is of type <code>PMRect</code>. The size returned is in your application drawing resolution, which you can obtain by calling <code>PMGetResolution</code>.</p>
<code>PMGetUnadjustedPaperRect</code>	<p>Gets the true size of the paper in points, unaffected by rotation, resolution, or scaling.</p>
<code>PMSetUnadjustedPaperRect</code>	<p>Sets printing to a particular paper size, in points, unaffected by rotation, resolution, or scaling.</p> <p>This function allows applications to request a particular paper size. If the driver cannot handle the specified size an error of <code>kPMValueOutOfRange</code> is returned. If the size is accepted, the application should still call <code>PMGetUnadjustedPaperRect</code> to verify.</p>

<i>Function</i>	<i>Description</i>
<code>PMGetUnadjustedPageRect</code>	Gets the size of the imageable area in points, unaffected by rotation, resolution, or scaling.
<code>PMGetResolution</code>	Gets the application's current drawing resolution. On return, the <code>res</code> parameter contains a pointer to a structure of type <code>PMResolution</code> , which describes the resolution at which the Carbon Printing Manager expects your application to render images: <pre>struct PMResolution {     double hRes;    // The horizontal resolution                     // in dpi.     double vRes;    // The vertical resolution in                     // dpi. };</pre>
<code>PMSetResolution</code>	Sets the application's drawing resolution.
<code>PMGetOrientation</code>	Gets the current page orientation setting. On return, the <code>orientation</code> parameter contains a pointer to a variable of type <code>PMOrientation</code> , which describes the current page orientation: <pre>kMPPortrait          = 1 kPMLandscape         = 2 kPMReversePortrait   = 3 kPMReverseLandscape  = 4</pre>
<code>PMSetOrientation</code>	Sets the page orientation for printing.
<code>PMGetScale</code>	Returns the scaling factor currently applied to the page and paper rectangles.
<code>PMSetScale</code>	Sets print scaling.
<code>PMGetPageFormatExtendedData</code>	Gets additional page format data previously stored by your application.
<code>PMSetPageFormatExtendedData</code>	Stores application-supplied data in a <code>PMPageFormat</code> object.

## Assigning Default Parameters

A call to `PMSessionDefaultPageFormat` will assign default parameters to a `PMPageFormat` object for the specified printing session.

## Validating a PMPageFormat Object

A call to `PMSessionValidatePageFormat` will validate a `PMPageFormat` object's parameters within the context of the specified printing session. `true` is returned in the `result` parameter if any parameters had to be changed.

## PMPrintSettings Object

The `PMPrintSettings` object stores information such as the number of copies, range of pages to print, and so on, for a particular printing session.

You use the function `PMCreatePrintSettings` to create an instance of this opaque object. `PMCreatePrintSettings` returns a reference to the object, which is created empty of settings. When your application displays a Print dialog, and the user clicks the Print button to dismiss the dialog, the Carbon Printing Manager saves the settings in the `PMPrintSettings` object.

As will be seen, `PMPrintSettings` objects are extensible, meaning that your applications can store additional data in them and that your application should never assume that they are of a fixed size.

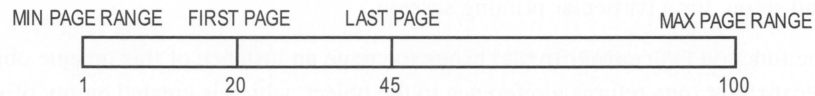
## Accessor Functions

The following describes the accessor functions you can use to obtain information contained within `PMPrintSettings` objects.

<i>Function</i>	<i>Description</i>
<code>PMGetFirstPage</code>	Gets the starting page number of the pages to be printed.
<code>PMSetFirstPage</code>	Sets the page number of the first page to be printed.
<code>PMGetLastPage</code>	Gets the last page number of the pages to be printed.
<code>PMSetLastPage</code>	Sets the page number of the first page to be printed.
<code>PMGetPageRange</code>	Gets the valid range of pages to print, as previously set by <code>PMSetPageRange</code> . If none was set by the application, the default range (1–32000) is returned.
<code>PMSetPageRange</code>	Sets the valid range of pages to be printed. On Mac OS X, if the user enters a value outside this range in the Print dialog, an alert message is displayed. This feature is not supported on Mac OS 8/9.



<i>Function</i>	<i>Description</i>
	The relationship between the page range set by the application using <code>PMSetPageRange</code> and the first and last pages set by the user in the Print dialog (and retrieved by <code>PMGetFirstPage</code> and <code>PMGetLastPage</code> ) is shown in Fig 4.



**FIG 4 - FIRST PAGE, LAST PAGE, AND PAGE RANGE (EXAMPLE)**

<code>PMGetCopies</code>	Gets the number of copies to be printed.
<code>PMSetCopies</code>	Sets the default value to be displayed for the number of copies to be printed.
<code>PMGetPrintSettingsExtendedData</code>	Gets additional print settings previously saved by your application.
<code>PMSetPrintSettingsExtendedData</code>	Stores application-supplied data in a <code>PMPrintSettings</code> object.
<p><b>Note:</b> You pass <code>true</code> in the <code>lock</code> parameter of the functions <code>PMSetCopies</code>, <code>PMSetFirstPage</code>, and <code>PMSetLastPage</code> if you wish to lock, respectively, the number-of-copies, first-page, and last-page fields in the Print dialog. Passing <code>true</code> only affects printer drivers for Mac OS X and LaserWriter printer drivers version 8.7 and later. If you pass <code>true</code> for other printer drivers, these functions will return <code>kPMLockIgnored</code>.</p>	

## Assigning Default Parameters

A call to `PMSessionDefaultPrintSettings` will assign default parameters to a `PMPrintSettings` object for the specified printing session.

## Validating a `PMPrintSettings` Object

A call to `PMSessionValidatePrintSettings` will validate a `PMPrintSettings` object's parameters within the context of the specified printing session. `true` is returned in the `result` parameter if any parameters had to be changed.



## Printing a Document

The following describes a typical approach to printing a document.

### When the User Chooses Page Setup... from the File Menu

When the user invokes the Page Setup dialog

- Call a function which
  - Calls `PMCreateSession` to create a `PMPrintSession` object, and associates that object with the document's window.
  - If a `PMPageFormat` object has not previously been created and associated with the document's window
    - Calls `PMCreatePageFormat` to create a `PMPageFormat` object
    - Calls `PMSessionDefaultPageFormat` to assign default parameters to the `PMPageFormat` object
    - Associates the `PMPageFormat` object with the document's window
  - If a `PMPageFormat` object has previously been created and associated with the document's window, calls `PMSessionValidatePageFormat` to validate the `PMPageFormat` object's parameters within the context of this printing session.
- Call `PMSessionPageSetupDialog` to present the Page Setup dialog, handle all user interaction within the dialog, and record the user's settings in the `PMPageFormat` object.
- When the user dismisses the Page Setup dialog, call `PMRelease` to release the `PMPrintSession` object.

### When the User Chooses Print... from the File Menu

When the user invokes the Print dialog

- As when the Page Setup dialog is invoked, call a function which
  - Creates a `PMPrintSession` object and associates it with the document's window.
  - Either creates a `PMPageFormat` object, assigns default parameters to it, and associates it with the document's window or, if this has previously been done, validates the existing `PMPageFormat` object's parameters.
- Call `PMCreatePrintSettings` to create a `PMPrintSettings` object.
- Call `PMSessionDefaultPrintSettings` to assign default parameters to the `PMPrintSettings` object.
- Associate the `PMPrintSettings` object with the document's window.

- For Mac OS X only
  - Call `PMSetPageRange` to set the valid range of pages that can be printed.
  - Call `PMSetFirstPage` and `PMSetLastPage` to set the default first and last pages to be printed, as displayed in the From and To fields of the Print dialog. (To clear the From and To fields and select the All radio button, pass `kMPrintAllPages` in the `PMSetLastPage` call.)
- Call `PMSessionPrintDialog` to present the Print dialog, handle all user interaction within the dialog, and record the user's settings in the `PMPrintSettings` object.
- If the user clicks the Cancel button in the Print dialog, call `PMRelease` to release the `PMPrintSettings` and `PMPrintSession` objects, and disassociate them from the document's window.
- If the user clicks the Print button in the Print dialog, call your application's **printing loop** function.

## The Printing Loop Function

The printing loop is the part of your application's code that performs the actual printing. The function containing the printing loop should perform the following actions:

- Call `PMGetFirstPage` and `PMGetLastPage` to get the first and last pages to print, as entered by the user in the Print dialog.
- Call a function which calculates the actual number of pages in the document. If necessary, adjust the value in the variable containing the last page as returned by `PMGetLastPage`.
- For Mac OS X, call `PMSetFirstPage` and `PMSetLastPage` to tell the Carbon Printing Manager which pages will be spooled so that the progress dialog can display an accurate page count. Pass in the values returned by the `PMGetFirstPage` and `PMGetLastPage` calls, the latter adjusted as necessary.
- Call `PMSessionBeginDocument` to create an instance of a `PMPrintContext` object and thus establish a graphics context for imaging the document. (As will be seen, a function exists to obtain the graphics port (that is, the printing port) associated with this object.)
- Print the pages. In the page-printing loop, all of the pages in the document should be spooled and the Carbon Printing Manager relied upon to print the correct page range as specified in the Print dialog. Note that your printing loop does not have to concern itself with the number of copies, since this is handled automatically by the Carbon Printing Manager. The pages loop should
  - Call `PMSessionBeginPage` to initialize the printing port. (Note that, for Mac OS 8/9 only, you can pass a scaling (bounding) rectangle in the `pageFrame` parameter, in

which case all items drawn in the printing port will be scaled to fit this page rectangle. If no scaling is required, pass NULL in the `pageFrame` parameter.)

- Call `GetPort` to save the current graphics port, call `PMSessionGetGraphicsContext` to obtain the current printing port, and call `SetPort` to set that port as the current port.
- Call a function which draws the relevant page in the printing port, then call `SetPort` to set the port saved by the `GetPort` call as the current port.
- Call `PMSessionEndPage` to print the page.
- When all copies of all pages have been printed, call `PMSessionEndDocument` to close the printing graphics port.
- Call `PMRelease` to release the `PMPrintSettings` and `PMPrintSession` objects.

## Call Sequence and Scope

When writing functions that call Carbon Printing Manager functions, bear in mind that the Carbon Printing Manager enforces a **sequence** of steps in the printing loop, and defines a valid **scope** for each Carbon Printing manager function. Functions used out of sequence will return a result code of `kPMOutOfScope`.

### Sequence and Scope: Session Functions

The following, in which scope level is represented by indentation, shows calling sequence and scope requirements of the main session printing functions. It shows, for example, that you can call `PMSessionGetGraphicsContext` only after calling `PMSessionBeginPage`.

```
PMCreateSession
    PMSessionDefaultPageFormat
    PMSessionValidatePageFormat
    PMSessionDefaultPrintSettings
    PMSessionValidatePrintSettings
    PMSessionError

    PMSessionPageSetupDialog
    PMSessionPrintDialog
    PMSessionPageSetupDialogInit
    PMSessionPrintDialogInit
    PMSessionPrintDialogMain
    PMSessionPageSetupDialogMain

    PMSessionBeginDocument
        PMSessionBeginPage
            PMSessionGetGraphicsContext
        PMSessionEndPage
    PMSessionEndDocument
```

These functions must be called  
before `PMSessionBeginDocument`

In general, functions may be called in any order with respect to other functions at the same or lower scope level.

## Sequence and Scope: Universal Functions

The following are the main universal functions which have no calling sequence or scope, and which may generally be used anywhere in your printing code:

PMCreatePageFormat	PMGetLastPage	PMGetScale
PMFlattenPageFormat	PMSetLastPage	PMSetScale
PMUnflattenPageFormat	PMGetCopies	PMGetResolution
PMCreatePrintSettings	PMSetCopies	PMSetResolution
PMFlattenPrintSettings	PMGetAdjustedPaperRect	PMGetPageFormatExtendedData
PMUnflattenPrintSettings	PMGetAdjustedPageRect	PMSetPageFormatExtendedData
PMGetPageRange	PMGetUnadjustedPageRect	PMGetPrintSettingsExtendedData
PMSetPageRange	PMSetUnadjustedPaperRect	PMSetPrintSettingsExtendedData
PMGetFirstPage	PMGetOrientation	
PMSetFirstPage	PMSetOrientation	

## Handling Printing Errors

The Carbon Printing Manager must necessarily bear the heavy burden of maintaining backward compatibility with early printer models and of maintaining compatibility with a great many existing printer drivers. For this reason, you must be especially wary of, and defensive about, possible error conditions when using Carbon Printing Manager functions.

Do not display an alert to report an error until the end of the printing loop. This is important for two reasons:

- If you display an alert in the middle of a printing loop, it could cause errors that might terminate an otherwise normal printing operation.
- The printer driver may have already displayed its own alert reporting the error.

## Text on the Screen and the Printed Page

At the application level, printing on the Macintosh computer is not fundamentally different from drawing on the screen. That said, printing text poses special challenges.

A common complication results from the difference in resolution and pixel size between screen and printer. QuickDraw measurements are theoretically in terms of **points**, which are nominally equivalent to screen pixels. High resolution printers have very much smaller pixels, although printer drivers are expected to take this into account so that the same QuickDraw calls will produce text lines of the same width on the screen and on the printer. Nevertheless, this higher resolution, and the fact that printers may use different fonts from those used for screen display, can result in some loss of fidelity from the screen to the printed page. In this regard, the following is relevant:

- QuickDraw places text glyphs on the screen at screen pixel intervals, whereas a printer can provide much finer placements on the printed page. This situation presents a choice between optimizing the appearance of text on the screen or on the printed page. In effect, that choice is whether to specify **fractional glyph widths** or **integer glyph widths**.

**NOTE**

A glyph is the visual representation of a character. See Chapter 21.

Fractional glyph widths are measurements of a glyph's width which can include fractions of a pixel. Using fractional glyph widths improves the appearance of printed text because it makes it possible for the printer, with its very high resolution, to print with better spacing. However, because screen glyphs are made up of whole pixels, QuickDraw cannot draw a fractional glyph on the screen, so it rounds off the fractional parts. This results in some degradation in the appearance of the text, in terms of character spacing, on the screen.

The alternative (integer glyph widths) gives more pleasing screen results because the characters are drawn with regular pixel spacing, but this may possibly be at the price of a printed page which is typographically unacceptable.

The Font Manager function `SetFractEnable` is used to turn fractional glyph widths on and off. `SetFractEnable` affects functions which draw text and which calculate text and character widths.

- Printer drivers attempt to reproduce faithfully the text formatting as drawn by QuickDraw on the screen, including keeping the same intended character spacing, line breaks and page breaks. However, because printers can have resident fonts that are different from the fonts that QuickDraw uses, because the drivers may handle text layout somewhat differently than QuickDraw, and because font metrics do not always scale linearly, fidelity may not always be achieved. Typically, identical line breaks and page breaks can be maintained, but character spacing can be noticeably different.

## Customizing the Page Setup and Print Dialogs

As previously stated, you may want to add additional options to the Page Setup and Print dialogs so that the user can further customize the printing process. For example, you might want to add a “skip blank pages” checkbox to a Print dialog.

**NOTE**

On Mac OS X, the **printing dialog extension (PDE)** mechanism may be used to extend the Page Setup and Print dialogs. The PDE mechanism provides great flexibility in extending printing dialogs. However, because the PDE mechanism applies only to Mac OS X, that method of extending Page Setup and Print dialogs is not addressed in this book. The method addressed is sometimes referred to as the AppendDITL method.



A limitation of the AppendDITL method is that it prevents you from creating the Page Setup and Print dialogs as window-modal (sheet) dialogs. This limitation does not apply when the PDE method is used.

The functions `PMSessionPageSetupDialogMain` and `PMSessionPrintDialogMain` are used to display Page Setup and Print dialogs customized using the AppendDITL method.

## The PMDialog Object

Your application uses a reference to a `PMDialog` object when creating custom Page Setup and Print dialogs. The functions `PMSessionPageSetupDialogInit` and `PMSessionPrintDialogInit` functions are used to create and initialize instances of this opaque object. Taking the reference to this object as a parameter, the function `PMGetDialogPtr` returns a pointer to the dialog structure.

## Customizing a Print Dialog

As an example, to customize a Print dialog, you must modify the contents of the `PMDialog` object before the dialog is drawn on the screen. This involves

- Providing a 'DITL' resource containing the required additional items.
- Defining an **item evaluation function** that handles events involving the additional items.
- Defining and installing an **initialization function** that
  - Calls `AppendDITL` to append the additional items to the dialog.
  - Using `PMGetItemProc`, gets the universal procedure pointer to the printer driver's item evaluation function from the `PMDialog` object, and saves it. (The printer driver's item evaluation function will need to be called from your item evaluation function to handle hits on the dialog's standard items.)
  - Calls `PMSetItemProc` to set a universal procedure pointer to your item evaluation function in the `PMDialog` object.
- If required, defining a custom event filter function and setting a universal procedure pointer to it in the `PMDialog` object using `PMSetModalFilterProc`.

A universal procedure pointer to the initialization function should then be passed in the `myInitProc` parameter of `PMSessionPrintDialogMain`, which displays the customized Print dialog.

## Displaying Page Setup and Print Dialogs As Window-Modal (Sheet) Dialogs

To cause Page Setup and Print dialogs to be created as window-modal (sheet) dialogs on Mac OS X, you should call the function `PMSessionUseSheets` immediately before the calls to `PMSessionPageSetupDialog` and `PMSessionPrintDialog`, passing the window reference for the parent window in the `documentWindow` parameter and a universal procedure pointer to an application-defined (callback) function in the `sheetDoneProc` parameter. The callback function should perform the actions required immediately following dismissal of the dialog, and should be declared like this:

```
void myPageSetupSheetDoneFunction(PMPrintSession printSession, WindowRef documentWindow,
                                   Boolean accepted);
```

The `accepted` formal parameter will be set to `true` if the Print/OK push button is clicked and to `false` if the Cancel push button is clicked.

The functions `NewPMSheetDoneUPP` and `DisposePMSheetDoneUPP` create and dispose of the universal procedure pointers.

## Saving and Retrieving a Page Format Object

As previously stated, the only information you should preserve each time the user prints a document should be that obtained via the Page Setup dialog. Ordinarily, therefore, you will want your application to save the flattened `PMPageFormat` object associated with a specific document in either the data fork or the resource fork of that document's file when you save the document itself.

You can store additional data inside the `PMPageFormat` object before it is flattened and saved by calling `PMSetPageFormatExtendedData`, whose parameters include a unique code identifying the data, the size of the data, and a pointer to the data. When the flattened `PMPageFormat` object is retrieved and unflattened, you can obtain this data by calling `PMGetPageFormatExtendedData`.

Saving a flattened `PMPageFormat` object to the resource fork of a file, and retrieving the flattened object from the file, is demonstrated in the demonstration program associated with Chapter 19.

## Printing from the Finder—Mac OS 8/9

Users generally print documents that are open on the screen one at a time while the application that created the document is running. However, on Mac OS 8/9, users can also print one or more documents from the Finder by selecting the documents and choosing Print... from the



Finder's File menu. This causes the Finder to launch the application and pass it a required Apple event (the Print Documents event) indicating the documents to be printed. In response to a Print Documents event, your application should

- Use saved or default page setup settings instead of displaying the Page Setup dialog
- Display the Print dialog once only, and use `PMCopyPrintSettings` to apply the information specified by the user to all of the selected documents
- Remain open unless and until the Finder sends it a Quit Application event

## Main Carbon Printing Manager Constants, Data Types and Functions

### Constants

#### Unwanted Data

<code>KPMNoData</code>	= <code>NULL</code>
<code>KPMDontWantSize</code>	= <code>NULL</code>
<code>KPMDontWantData</code>	= <code>NULL</code>
<code>KPMDontWantBoolean</code>	= <code>NULL</code>
<code>KPMNoPrintSettings</code>	= <code>NULL</code>
<code>kPMNoPageFormat</code>	= <code>NULL</code>
<code>kPMNoReference</code>	= <code>NULL</code>

#### Page Orientation

<code>kPMPortrait</code>	= 1
<code>kPMLandscape</code>	= 2
<code>kPMReversePortrait</code>	= 3
<code>kPMReverseLandscape</code>	= 4

#### User Cancelled

<code>kPMCancel</code>	= 128
------------------------	-------

#### For `PMSetPageRange` and `PMSetLastPage`

<code>kPMPrintAllPages</code>	= -1
-------------------------------	------

#### Result Codes

<code>kPMNoError</code>	= 0
<code>kPMGeneralError</code>	= -30870
<code>kPMOutOfScope</code>	= -30871
<code>kPMInvalidParameter</code>	= <code>paramErr</code>
<code>kPMNoDefaultPrinter</code>	= -30872
<code>kPMNotImplemented</code>	= -30873
<code>kPMNoSuchEntry</code>	= -30874
<code>kPMInvalidPrintSettings</code>	= -30875
<code>kPMInvalidPageFormat</code>	= -30876
<code>kPMValueOutOfRange</code>	= -30877
<code>kPMLockIgnored</code>	= -30878

```

kPMInvalidPrintSession = -30879
kPMInvalidPrinter      = -30880
kPMObjectInUse         = -30881

```

## Data Types

### Opaque Types

```

typedef struct OpaquePMPrintSession* PMPrintSession;
typedef struct OpaquePMPageFormat*   PMPageFormat;
typedef struct OpaquePMPrintSettings* PMPrintSettings;
typedef struct OpaquePMPrintContext* PMPrintContext;
typedef struct OpaquePMDialog*       PMDialog;

```

### PMRect

```

struct PMRect
{
    double top;
    double left;
    double right;
    double bottom;
}

```

### PMResolution

```

struct PMResolution
{
    double hRes;
    double vRes;
}

```

## Functions

### Managing Printing Objects

```

OSStatus PMRetain(PMObject object);
OSStatus PMRelease(PMObject object);

```

### Print Loop

```

OSStatus PMCreateSession(PMPrintSession *printSession);
OSStatus PMSessionBeginDocument(PMPrintSession printSession, PMPrintSettings printSettings,
    PMPageFormat pageFormat);
OSStatus PMSessionEndDocument(PMPrintSession printSession);
OSStatus PMSessionBeginPage(PMPrintSession printSession, PMPageFormat pageFormat,
    const PMRect *pageFrame);
OSStatus PMSessionEndPage(PMPrintSession printSession);
OSStatus PMSessionGetGraphicsContext(PMPrintSession printSession,
    CFStringRef graphicsContextType, void **graphicsContext);

```

### Page Format and Print Settings Objects

```

OSStatus PMCreatePageFormat(PMPageFormat *pageFormat);
OSStatus PMCreatePrintSettings(PMPrintSettings *printSettings);
OSStatus PMSessionDefaultPageFormat(PMPrintSession printSession, PMPageFormat pageFormat);

```

```

OSStatus PMSessionDefaultPrintSettings(PMPrintSession printSession,
    PMPrintSettings printSettings);
OSStatus PMSessionValidatePageFormat(PMPrintSession printSession, PMPageFormat pageFormat,
    Boolean *result);
OSStatus PMSessionValidatePrintSettings(PMPrintSession printSession,
    PMPrintSettings printSettings, Boolean *result);
OSStatus PMCCopyPageFormat(PMPageFormat formatSrc, PMPageFormat formatDest);
OSStatus PMCopyPrintSettings(PMPrintSettings settingSrc, PMPrintSettings settingDest);
OSStatus PMFlattenPageFormat(PMPageFormat pageFormat, Handle *flatFormat);
OSStatus PMUnflattenPageFormat(Handle flatFormat, PMPageFormat *pageFormat);
OSStatus PMFlattenPrintSettings(PMPrintSettings printSettings, Handle *flatSetting);
OSStatus PMUnflattenPrintSettings(Handle flatSetting, PMPrintSettings *printSettings);

```

### Displaying the Page Setup and Print Dialogs

```

OSStatus PMSessionPageSetupDialog(PMPrintSession printSession, PMPageFormat pageFormat,
    Boolean *accepted);
OSStatus PMSessionPrintDialog(PMPrintSession printSession, PMPrintSettings printSettings,
    PMPageFormat constPageFormat, Boolean* accepted);
OSStatus PMSessionUseSheets(PMPrintSession printSession, WindowRef documentWindow,
    PMSheetDoneUPP sheetDoneProc);

```

### Customizing Page Setup and Print Dialogs

```

OSStatus PMSessionPageSetupDialogInit(PMPrintSession printSession, PMPageFormat pageFormat,
    PMDialog *newDialog);
OSStatus PMSessionPrintDialogInit(PMPrintSession printSession, PMPrintSettings printSettings,
    PMPageFormat constPageFormat, PMDialog *newDialog);
OSStatus PMSessionPageSetupDialogMain(PMPrintSession printSession, PMPageFormat pageFormat,
    Boolean *accepted, PMPageSetupDialogInitUPP myInitProc);
OSStatus PMSessionPrintDialogMain(PMPrintSession printSession, PMPrintSettings printSettings,
    PMPageFormat constPageFormat, Boolean *accepted, PMPrintDialogInitUPP myInitProc);
OSStatus PMSetModalFilterProc(PMDialog pmDialog, ModalFilterUPP filterProc);
OSStatus PMSetItemProc(PMDialog pmDialog, PMItemUPP itemProc);
OSStatus PMGetItemProc(PMDialog pmDialog, PMItemUPP *itemProc);
OSStatus PMGetDialogPtr (PMDialog pmDialog, DialogRef *theDialog);

```

### Getting and Setting Page Setup Information

```

OSStatus PMGetAdjustedPaperRect(PMPageFormat pageFormat, PMRect *paperRect);
OSStatus PMGetAdjustedPageRect(PMPageFormat pageFormat, PMRect *pageRect);
OSStatus PMGetUnadjustedPaperRect(PMPageFormat pageFormat, PMRect *paperSize);
OSStatus PMSetUnadjustedPaperRect(PMPageFormat pageFormat, const PMRect paperSize);
OSStatus PMGetUnadjustedPageRect(PMPageFormat pageFormat, PMRect *pageSize);
OSStatus PMGetResolution(PMPageFormat pageFormat, PMResolution *res);
OSStatus PMSetResolution(PMPageFormat pageFormat, const PMResolution res);
OSStatus PMSetOrientation(PMPageFormat pageFormat, PMOrientation orientation, Boolean lock);
OSStatus PMGetOrientation(PMPageFormat pageFormat, PMOrientation *orientation);
OSStatus PMGetScale(PMPageFormat pageFormat, double *scale);
OSStatus PMSetScale(PMPageFormat pageFormat, double scale);
OSStatus PMGetPageFormatExtendedData(PMPageFormat pageFormat, OSType dataID, UInt32 *size,
    void *extendedData);
OSStatus PMSetPageFormatExtendedData(PMPageFormat pageFormat, OSType dataID, UInt32 size,
    void *extendedData);

```

## Getting and Setting Printing Information

```
OSStatus PMGetFirstPage(PMPrintSettings printSettings, UInt32 *first);
OSStatus PMSetFirstPage(PMPrintSettings printSettings, UInt32 first, Boolean lock);
OSStatus PMGetLastPage(PMPrintSettings printSettings, UInt32 *last);
OSStatus PMSetLastPage(PMPrintSettings printSettings, UInt32 last, Boolean lock);
OSStatus PMGetPageRange(PMPrintSettings printSettings, UInt32 *minPage, UInt32 *maxPage);
OSStatus PMSetPageRange(PMPrintSettings printSettings, UInt32 minPage, UInt32 maxPage);
OSStatus PMGetCopies(PMPrintSettings printSettings, UInt32 *copies);
OSStatus PMSetCopies(PMPrintSettings printSettings, UInt32 copies, Boolean lock);
OSStatus PMGetPrintSettingsExtendedData(PMPrintSettings printSettings, OSType dataID,
    UInt32 *size, void *extendedData);
OSStatus PMSetPrintSettingsExtendedData(PMPrintSettings printSettings, OSType dataID,
    UInt32 size, void *extendedData);
```

## Creating and Disposing of Universal Procedure Pointers

```
PMPageSetupDialogInitUPP NewPMPageSetupDialogInitUPP(PMPageSetupDialogInitProcPtr userRoutine);
PMPrintDialogInitUPP NewPMPrintDialogInitUPP(PMPrintDialogInitProcPtr userRoutine);
PMItemUPP NewPMItemUPP(PMItemProcPtr userRoutine);
PMIdleUPP NewPMIdleUPP(PMIdleProcPtr userRoutine);
PMSheetDoneUPP NewPMSheetDoneUPP(PMSheetDoneProcPtr userRoutine);
void DisposePMPageSetupDialogInitUPP(PMPageSetupDialogInitUPP userUPP);
void DisposePMPrintDialogInitUPP (PMPrintDialogInitUPP userUPP);
void DisposePMItemUPP(PMItemUPP userUPP);
void DisposePMIdleUPP(PMIdleUPP userUPP);
void DisposePMSheetDoneUPP(PMSheetDoneUPP userUPP);
```

## Errors

```
OSStatus PMSessionError(PMPrintSession printSession);
```

## Application-Defined (Callback) Functions

```
void myPMDialogSheetDoneFunction(PMPrintSession printSession, WindowRef documentWindow,
    Boolean accepted);
```

# Demonstration Program CarbonPrinting Listing

```
// *****
// CarbonPrinting.h CLASSIC EVENT MODEL
// *****
//
// This program:
//
// • Demonstrates printing using the Carbon Printing Manager session functions.
//
// • Opens two windows. The first window is a document window in which is displayed the
//   document to be printed. The second window displays some printing-related information
//   obtained from PMPageFormat and PMPrintSettings objects.
//
// • Customizes the Print dialog by adding a pop-up menu button, three radio buttons, a
//   checkbox, and a group box.
//
// • Allows the user to print a document containing a picture and text, with the text
//   being printed in the font and font size, and with the fractional widths setting,
//   specified using the items added to the Print dialog.
//
```

```

// The customizing of the Print dialog uses the AppendDITL method. Accordingly, on Mac OS X,
// the dialogs are application-modal and are not displayed as window-modal sheet dialogs.
//
// The program utilizes the following resources:
//
// • A 'plst' resource.
//
// • 'MBAR' resource and associated 'MENU' resources (preload, non-purgeable).
//
// • Two 'WIND' resources (purgeable).
//
// • A 'TEXT' resource (purgeable) used for printing.
//
// • A 'PICT' resource (non-purgeable) used for printing.
//
// • 'CNTL' resources (purgeable) for controls added to the Print dialog box.
//
// • A 'DITL' resource (purgeable) specifying the items to be appended to the Print dialog
//   box.
//
// • A 'MENU' resource (preload, non-purgeable) for the pop-up menu button.
//
// • A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenubar 128
#define mAppleApplication 128
#define iAbout 1
#define mFile 129
#define iPageSetup 9
#define iPrint 10
#define iQuit 12
#define mFont 131
#define rDocWindow 128
#define rInfoWindow 129
#define rText 128
#define rPicture 128
#define rPrintDialogAppendDITL 128
#define iPopupButton 1
#define iRadioButton10pt 2
#define iRadioButton12pt 3
#define iRadioButton14pt 4
#define iCheckboxFracWidths 5
#define kMargin 90
#define MAX_UINT32 0xFFFFFFFF
#define MIN(a,b) ((a) < (b) ? (a) : (b))

```

```
// ..... typedefs

typedef struct
{
    PMPrintSession    printSession;
    PMPageFormat      pageFormat;
    PMPrintSettings   printSettings;
    TEHandle           editTextStrucHdl;
    PicHandle         pictureHdl;
} docStructure, *docStructurePtr, **docStructureHdl;

// ..... function prototypes

void      main                                (void);
void      doPreliminaries                    (void);
OSErr     quitAppEventHandler                 (AppleEvent *,AppleEvent *,SInt32);
void      doGetDocument                      (void);
void      doEvents                           (EventRecord *);
void      doUpdate                           (EventRecord *);
void      doUpdateDocumentWindow             (WindowRef);
void      doMenuChoice                       (SInt32);
OSStatus  doCreateOrValidatePageFormat       (WindowRef);
OSStatus  doPageSetUpDialog                  (WindowRef);
OSStatus  doPrintSettingsDialog              (WindowRef);
OSStatus  doPrinting                         (WindowRef);
SInt16    doCalcNumberOfPages                (WindowRef,Rect);
void      doDrawPage                         (WindowRef,Rect,SInt16,SInt16);
void      doDrawPrintInfo                    (void);
void      doDrawRectStrings                  (Str255,SInt16,SInt16,Str255,SInt16,SInt16,Str255);
void      doErrorAlert                       (OSStatus);
void      doConcatPStrings                   (Str255,Str255);

void      initializationFunction               (PMPrintSettings, PMDialog *);
void      itemEvaluationFunction              (DialogPtr,SInt16);
Boolean   eventFilter                        (DialogPtr,EventRecord *,SInt16 *);

// *****
// CarbonPrinting.c
// *****

// ..... includes

#include "CarbonPrinting.h"

// ..... global variables

Boolean    gRunningOnX = false;
WindowRef  gDocumentWindowRef, gPrintInfoWindowRef;
SInt16     gFontNumber;
SInt16     gFontSize;
Boolean    gDone;
PMItemUPP  gNewItemEvaluateFunctionUPP;
ModalFilterUPP gEventFilterUPP;
PMPrintSettings gPrintSettings = kPMNoPrintSettings;
```

```

PMDialog      gPMDialog;
UInt32        gFirstPage, gLastPage, gCopies;
Boolean       gDrawPrintSettingsStuff;

// ***** main

void main(void)
{
    MenuBarHandle  menubarHdl;
    SInt32         response;
    MenuRef        menuRef;
    docStructureHdl docStrucHdl;
    SInt16         fontNum;
    RGBColor       whiteColor = { 0xFFFF, 0xFFFF, 0xFFFF };
    RGBColor       blueColor  = { 0x4444, 0x4444, 0x9999 };
    Rect           portRect;
    EventRecord     eventStructure;
    Boolean         gotEvent;

    // ..... do preliminaries

    doPreliminaries();

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMenubar);
    if(menubarHdl == NULL)
        ExitToShell();
    SetMenuBar(menubarHdl);
    DrawMenuBar();

    Gestalt(gestaltMenuMgrAttr,&response);
    if(response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
        {
            DeleteMenuItem(menuRef,iQuit);
            DeleteMenuItem(menuRef,iQuit - 1);
        }

        gRunningOnX = true;
    }

    // ..... open document window and attach document structure

    if(!(gDocumentWindowRef = GetNewCWindow(rDocWindow,NULL,(WindowRef)-1)))
        ExitToShell();

    SetPortWindowPort(gDocumentWindowRef);
    GetFNum("\pGeneva",&fontNum);
    TextFont(fontNum);
    TextSize(10);
    gFontNumber = fontNum;
    gFontSize = 10;

```



```

if(!(docStrucHdl = (docStructureHdl) NewHandle(sizeof(docStructure))))
    ExitToShell();
SetWRefCon(gDocumentWindowRef,(SInt32) docStrucHdl);

(*docStrucHdl)->printSession = NULL;
(*docStrucHdl)->pageFormat = kPMNoPageFormat;
(*docStrucHdl)->printSettings = kPMNoPrintSettings;

// ..... open printing information window

if(!(gPrintInfoWindowRef = GetNewCWindow(rInfoWindow,NULL,(WindowRef)-1)))
    ExitToShell();

SetPortWindowPort(gPrintInfoWindowRef);
SetFont(fontNum);
TextSize(10);
RGBForeColor(&whiteColor);
RGBBackColor(&blueColor);
GetWindowPortBounds(gPrintInfoWindowRef,&portRect);
EraseRect(&portRect);

// ..... load and display simulated document

doGetDocument();

// ..... event loop

gDone = false;

while(!gDone)
{
    gotEvent = WaitNextEvent(everyEvent,&eventStructure,MAX_UINT32,NULL);
    if(gotEvent)
        doEvents(&eventStructure);
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    OSErr osError;

    MoreMasterPointers(128);
    InitCursor();
    FlushEvents(everyEvent,0);

    osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
                                   NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
                                   0L,false);

    if(osError != noErr)
        ExitToShell();
}

```

```
// ***** doQuitAppEvent

OSErr quitAppEventHandler(AppleEvent *appEvent, AppleEvent *reply, SInt32 handlerRefcon)
{
    OSErr    osError;
    DescType returnedType;
    Size      actualSize;

    osError = AEGetAttributePtr(appEvent, keyMissedKeywordAttr, typeWildCard, &returnedType, NULL, 0,
                                &actualSize);

    if (osError == errAEDescNotFound)
    {
        gDone = true;
        osError = noErr;
    }
    else if (osError == noErr)
        osError = errAEParamMissed;

    return osError;
}

// ***** doGetDocument

void doGetDocument(void)
{
    docStructureHdl docStrucHdl;
    Rect            portRect, destRect, viewRect;
    Handle          textHdl;

    SetPortWindowPort(gDocumentWindowRef);

    docStrucHdl = (docStructureHdl) GetWRefCon(gDocumentWindowRef);

    GetWindowPortBounds(gDocumentWindowRef, &portRect);
    destRect = portRect;
    InsetRect(&destRect, 4, 4);
    destRect.bottom += 4;
    viewRect = destRect;
    (*docStrucHdl)->editTextStrucHdl = TNew(&destRect, &viewRect);

    textHdl = GetResource('TEXT', rText);
    if (textHdl == NULL)
        ExitToShell();

    HLock(textHdl);
    TEInsert(*textHdl, GetHandleSize(textHdl), (*docStrucHdl)->editTextStrucHdl);
    HUnlock(textHdl);

    ReleaseResource(textHdl);

    (*docStrucHdl)->pictureHdl = GetPicture(rPicture);
    if ((*docStrucHdl)->pictureHdl == NULL)
        ExitToShell();
}
```

```

    InvalWindowRect(gDocumentWindowRef,&portRect);
}

// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    WindowRef    windowRef;
    WindowPartCode partCode;

    windowRef = (WindowRef) eventStrucPtr->message;

    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEProcessAppleEvent(eventStrucPtr);
            break;

        case mouseDown:
            partCode = FindWindow(eventStrucPtr->where,&windowRef);
            switch(partCode)
            {
                case inMenuBar:
                    doMenuChoice(MenuSelect(eventStrucPtr->where));
                    break;

                case inContent:
                    if(windowRef != FrontWindow())
                        SelectWindow(windowRef);
                    break;

                case inDrag:
                    DragWindow(windowRef,eventStrucPtr->where,NULL);
                    break;
            }
            break;

        case keyDown:
            if((eventStrucPtr->modifiers & cmdKey) != 0)
                doMenuChoice(MenuEvent(eventStrucPtr));
            break;

        case updateEvt:
            doUpdate(eventStrucPtr);
            break;
    }
}

// ***** doUpdate

void doUpdate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    GrafPtr    oldPort;
    Rect        portRect;

```

```

windowRef = (WindowRef) eventStrucPtr->message;

GetPort(&oldPort);

BeginUpdate(windowRef);

if(windowRef == gDocumentWindowRef)
    doUpdateDocumentWindow(windowRef);
else if(windowRef == gPrintInfoWindowRef)
{
    SetPortWindowPort(gPrintInfoWindowRef);
    GetWindowPortBounds(gPrintInfoWindowRef,&portRect);
    EraseRect(&portRect);
    doDrawPrintInfo();
}

EndUpdate(windowRef);

SetPort(oldPort);
}

// ***** doUpdateDocumentWindow

void doUpdateDocumentWindow(WindowRef windowRef)
{
    Rect          portRect, pictureRect, savedDestRect;
    docStructureHdl docStrucHdl;
    SInt16         savedFontNum, savedFontSize, savedLineHeight, fontNum;

    SetPortWindowPort(windowRef);
    GetWindowPortBounds(gDocumentWindowRef,&portRect);
    docStrucHdl = (docStructureHdl) GetWRefCon(windowRef);

    savedDestRect = ((*docStrucHdl)->editTextStrucHdl)->destRect;
    savedFontNum = ((*docStrucHdl)->editTextStrucHdl)->txFont;
    savedFontSize = ((*docStrucHdl)->editTextStrucHdl)->txSize;
    savedLineHeight = ((*docStrucHdl)->editTextStrucHdl)->lineHeight;

    ((*docStrucHdl)->editTextStrucHdl)->destRect = portRect;
    InsetRect(&((*docStrucHdl)->editTextStrucHdl)->destRect,4,4);
    ((*docStrucHdl)->editTextStrucHdl)->destRect.bottom += 4;
    GetFNum("pGeneva",&fontNum);
    ((*docStrucHdl)->editTextStrucHdl)->txFont = fontNum;
    ((*docStrucHdl)->editTextStrucHdl)->txSize = 10;
    ((*docStrucHdl)->editTextStrucHdl)->lineHeight = 13;
    TECalText((*docStrucHdl)->editTextStrucHdl);
    TEUpdate(&portRect,(*docStrucHdl)->editTextStrucHdl);

    ((*docStrucHdl)->editTextStrucHdl)->destRect = savedDestRect;
    ((*docStrucHdl)->editTextStrucHdl)->txFont = savedFontNum;
    ((*docStrucHdl)->editTextStrucHdl)->txFont = savedFontSize;
    ((*docStrucHdl)->editTextStrucHdl)->lineHeight = savedLineHeight;
}

```

```

SetRect(&pictureRect,2,2,180,134);
DrawPicture((*docStrucHdl)->pictureHdl,&pictureRect);
}

// ***** doMenuChoice

void doMenuChoice(SInt32 menuChoice)
{
    MenuID      menuID;
    MenuItemIndex menuItem;
    OSStatus     osStatus;
    Rect         portRect;

    menuID = HiWord(menuChoice);
    menuItem = LoWord(menuChoice);

    if(menuID == 0)
        return;

    switch(menuID)
    {
        case mAppleApplication:
            if(menuItem == iAbout)
                SysBeep(10);
            break;

        case mFile:
            if(menuItem == iPageSetup)
            {
                osStatus = doPageSetUpDialog(gDocumentWindowRef);
                if(osStatus != kPMNoError)
                    doErrorAlert(osStatus);
            }

            if(menuItem == iPrint)
            {
                osStatus = doPrintSettingsDialog(gDocumentWindowRef);
                if(osStatus == kPMNoError)
                {
                    osStatus = doPrinting(gDocumentWindowRef);
                    if(osStatus != kPMNoError)
                        doErrorAlert(osStatus);
                }
                else if(osStatus != kPMCancel)
                    doErrorAlert(osStatus);
            }

        case mWindow:
            GetWindowPortBounds(gPrintInfoWindowRef,&portRect);
            InvalWindowRect(gPrintInfoWindowRef,&portRect);

            if(menuItem == iQuit)
                gDone = true;
    }
}

```

```

        break;
    }

    HiliteMenu(0);
}

// ***** doCreateOrValidatePageFormat

OSStatus doCreateOrValidatePageFormat (WindowRef windowRef)
{
    docStructureHdl docStrucHdl;
    OSStatus      osStatus      = kPMNoError;
    PMPrintSession printSession = NULL;
    PMPageFormat   pageFormat   = kPMNoPageFormat;

    docStrucHdl = (docStructureHdl) GetWRefCon(windowRef);
    HLock((Handle) docStrucHdl);

    // ..... create printing session

    osStatus = PMCreateSession(&printSession);

    // ..... if necessary, create and store page format object, otherwise validate existing

    if(osStatus == noErr)
    {
        if((*docStrucHdl)->pageFormat == kPMNoPageFormat)
        {
            osStatus = PMCreatePageFormat(&pageFormat);

            if((osStatus == kPMNoError) && (pageFormat != kPMNoPageFormat))
            {
                osStatus = PMSessionDefaultPageFormat(printSession, pageFormat);

                if(osStatus == kPMNoError)
                    (*docStrucHdl)->pageFormat = pageFormat;
            }
            else
            {
                if(osStatus == kPMNoError)
                    osStatus = kPMGeneralError;
            }
        }
        else
        {
            osStatus = PMSessionValidatePageFormat(printSession, (*docStrucHdl)->pageFormat,
                                                    kPMDontWantBoolean);
        }
    }
}

```

```

// ..... store printing session, or clean up if error

if(osStatus == kPMNoError)
    (*docStrucHdl)->printSession = printSession;
else
{
    if(pageFormat != kPMNoPageFormat)
        PMRelease(pageFormat);
    if(printSession != NULL)
        PMRelease(printSession);
}

HUnlock((Handle) docStrucHdl);

return osStatus;
}

// ***** doPageSetUpDialog

OSStatus doPageSetUpDialog(WindowRef windowRef)
{
    OSStatus      osStatus = kPMNoError;
    docStructureHdl docStrucHdl;
    Boolean        userClickedOKButton;

    osStatus = doCreateOrValidatePageFormat (windowRef);
    if(osStatus != kPMNoError)
        return osStatus;

    docStrucHdl = (docStructureHdl) GetWRefCon(windowRef);
    HLock((Handle) docStrucHdl);

    osStatus = PMSessionPageSetupDialog((*docStrucHdl)->printSession, (*docStrucHdl)->pageFormat,
                                         &userClickedOKButton);

    if((*docStrucHdl)->printSession != NULL)
    {
        PMRelease((*docStrucHdl)->printSession);
        (*docStrucHdl)->printSession = NULL;
    }

    HUnlock((Handle) docStrucHdl);
    gDrawPrintSettingsStuff = false;

    return osStatus;
}

// ***** doPrintSettingsDialog

OSStatus doPrintSettingsDialog(WindowRef windowRef)
{
    OSStatus      osStatus = kPMNoError;
    docStructureHdl docStrucHdl;

```



```

PMPrintSettings    printSettings = kPMNoPrintSettings;
CFStringRef        stringRef;
PMPrintDialogInitUPP initializationFunctionUPP;
Boolean            userClickedPrintButton;

osStatus = doCreateOrValidatePageFormat (windowRef);
if(osStatus != kPMNoError)
    return osStatus;

docStrucHdl = (docStructureHdl) GetWRefCon(windowRef);
HLock((Handle) docStrucHdl);

osStatus = PMCreatePrintSettings(&printSettings);
if((osStatus == kPMNoError) && (printSettings != kPMNoPrintSettings))
{
    osStatus = CopyWindowTitleAsCFString(windowRef,&stringRef);
    if(osStatus == noErr)
    {
        osStatus = PMSetJobNameCFString(printSettings,stringRef);
        CFRelease(stringRef);
    }

    if(osStatus == noErr)
        osStatus = PMSessionDefaultPrintSettings((*docStrucHdl)->printSession,printSettings);

    if(osStatus == kPMNoError)
    {
        (*docStrucHdl)->printSettings = printSettings;
        printSettings = kPMNoPrintSettings;
    }
}

if(osStatus == kPMNoError)
{
    if(gRunningOnX)
    {
        PMSetPageRange((*docStrucHdl)->printSettings,1,kPMPrintAllPages);
        PMSetFirstPage((*docStrucHdl)->printSettings,1,false);
        PMSetLastPage((*docStrucHdl)->printSettings,9999,false);
    }
}

if(osStatus == kPMNoError)
{
    initializationFunctionUPP = NewPMPrintDialogInitUPP((PMPrintDialogInitProcPtr)
                                                         initializationFunction);
    gNewItemEvaluateFunctionUPP = NewPMItemUPP((PMItemProcPtr) itemEvaluationFunction);
    gEventFilterUPP = NewModalFilterUPP((ModalFilterProcPtr) eventFilter);

    osStatus = PMSessionPrintDialogInit((*docStrucHdl)->printSession,
                                         (*docStrucHdl)->printSettings,
                                         (*docStrucHdl)->pageFormat,&gPMDialog);
}

```

```

if(osStatus == kPMNoError)
    osStatus = PMSessionPrintDialogMain((*docStrucHdl)->printSession,
                                        (*docStrucHdl)->printSettings,
                                        (*docStrucHdl)->pageFormat,
                                        &userClickedPrintButton, initializationFunctionUPP);

if(osStatus == kPMNoError && !userClickedPrintButton)
    osStatus = kPMCancel;

DisposePMPrintDialogInitUPP(initializationFunctionUPP);
DisposePMItemUPP(gNewItemEvaluateFunctionUPP);
DisposeModalFilterUPP(gEventFilterUPP);
}

if(osStatus != kPMNoError || osStatus == kPMCancel)
{
    if((*docStrucHdl)->printSettings != kPMNoPrintSettings)
    {
        PMRelease((*docStrucHdl)->printSettings);
        (*docStrucHdl)->printSettings = kPMNoPrintSettings;
    }
    if((*docStrucHdl)->printSession != NULL)
    {
        PMRelease((*docStrucHdl)->printSession);
        (*docStrucHdl)->printSession = NULL;
    }
}

HUnlock((Handle) docStrucHdl);
gDrawPrintSettingsStuff = userClickedPrintButton;

return osStatus;
}

// ***** doPrinting

OSStatus doPrinting(WindowRef windowRef)
{
    docStructureHdl docStrucHdl;
    OSStatus        osStatus = kPMNoError;
    UInt32          firstPage, lastPage, numberOfPages;
    PMRect          adjustedPageRect;
    Rect            pageRect;
    SInt16          page;
    GrafPtr         oldPort, currentPort, printingPort;

    GetPort(&oldPort);
    docStrucHdl = (docStructureHdl) GetWRefCon(windowRef);
    HLock((Handle) docStrucHdl);

```

```

// ..... get first and last page to print as set by user in Print dialog

osStatus = PMGetFirstPage((*docStrucHdl)->printSettings,&firstPage);

if(osStatus == kPMNoError)
    osStatus = PMGetLastPage((*docStrucHdl)->printSettings,&lastPage);

// for demo purposes, store first, last page and copies for Some Printing Information window

gFirstPage = firstPage;
gLastPage = lastPage;
PMGetCopies((*docStrucHdl)->printSettings,&gCopies);

// ..... get actual number of pages in document and, if necessary, adjust last page

if(osStatus == kPMNoError)
    osStatus = PMGetAdjustedPageRect((*docStrucHdl)->pageFormat,&adjustedPageRect);

if(osStatus == kPMNoError)
{
    pageRect.top    = adjustedPageRect.top;
    pageRect.left   = adjustedPageRect.left;
    pageRect.bottom = adjustedPageRect.bottom;
    pageRect.right  = adjustedPageRect.right;

    numberOfPages = doCalcNumberOfPages(windowRef,pageRect);

    if(numberOfPages < lastPage)
        lastPage = numberOfPages;
}

// ..... for Mac OS X, set first and last page for progress dialog

if(gRunningOnX)
{
    if(osStatus == kPMNoError)
        osStatus = PMSetFirstPage((*docStrucHdl)->printSettings,firstPage,false);

    if(osStatus == kPMNoError)
        osStatus = PMSetLastPage((*docStrucHdl)->printSettings,lastPage,false);
}

// ..... printing loop

if(osStatus == kPMNoError)
{
    osStatus = PMSessionBeginDocument((*docStrucHdl)->printSession,
                                      (*docStrucHdl)->printSettings,
                                      (*docStrucHdl)->pageFormat);

    if(osStatus == kPMNoError)
    {
        page = 1;
    }
}

```

```

while((page <= lastPage) && (osStatus == kPMNoError) &&
      (PMSessionError((*docStrucHdl)->printSession) == kPMNoError))
{
    osStatus = PMSessionBeginPage((*docStrucHdl)->printSession,
                                   (*docStrucHdl)->pageFormat,NULL);

    if(osStatus != kPMNoError)
        break;

    GetPort(&currentPort);

    osStatus = PMSessionGetGraphicsContext((*docStrucHdl)->printSession,
                                           kPMGraphicsContextQuickdraw,
                                           (void **) &printingPort);

    if(osStatus == kPMNoError)
    {
        SetPort(printingPort);
        doDrawPage(windowRef,pageRect,page,numberOfPages);
        SetPort(currentPort);
    }

    osStatus = PMSessionEndPage((*docStrucHdl)->printSession);
    if(osStatus != kPMNoError)
        break;

    page++;
}
}

PMSessionEndDocument((*docStrucHdl)->printSession);
}

// ..... clean up

if((*docStrucHdl)->printSettings != kPMNoPrintSettings)
{
    PMRelease((*docStrucHdl)->printSettings);
    (*docStrucHdl)->printSettings = kPMNoPrintSettings;
}
if((*docStrucHdl)->printSession != NULL)
{
    PMRelease((*docStrucHdl)->printSession);
    (*docStrucHdl)->printSession = NULL;
}

HUnlock((Handle) docStrucHdl);
SetPort(oldPort);

return osStatus;
}

```

```
// ***** doCalcNumberOfPages

SInt16 doCalcNumberOfPages(WindowRef windowRef, Rect pageRect)
{
    docStructureHdl docStrucHdl;
    FontInfo         fontInfo;
    Rect             destRect;
    SInt16           heightDestRect, linesPerPage, numberOfPages;

    docStrucHdl = (docStructureHdl) GetWRefCon(windowRef);

    TextFont(gFontNumber);
    TextSize(gFontSize);
    GetFontInfo(&fontInfo);

    ((*docStrucHdl)->editTextStrucHdl)->txFont = gFontNumber;
    ((*docStrucHdl)->editTextStrucHdl)->txSize = gFontSize;
    ((*docStrucHdl)->editTextStrucHdl)->lineHeight = fontInfo.ascent + fontInfo.descent
                                                    + fontInfo.leading;

    SetRect(&destRect, pageRect.left + kMargin, pageRect.top + (kMargin * 1.5),
           pageRect.right - kMargin, pageRect.bottom - (kMargin * 1.5));

    ((*docStrucHdl)->editTextStrucHdl)->destRect = destRect;

    TECalText((*docStrucHdl)->editTextStrucHdl);

    heightDestRect = destRect.bottom - destRect.top;
    linesPerPage = heightDestRect / ((*docStrucHdl)->editTextStrucHdl)->lineHeight;
    numberOfPages = ((*docStrucHdl)->editTextStrucHdl)->nLines / linesPerPage + 1;

    return(numberOfPages);
}

// ***** doDrawPage

void doDrawPage(WindowRef windowRef, Rect pageRect, SInt16 pageNumber, SInt16 numberOfPages)
{
    docStructureHdl docStrucHdl;
    TEHandle         docEditTextStrucHdl, pageEditTextStrucHdl;
    PicHandle        pictureHdl;
    Rect             destRect, pictureRect;
    SInt16           heightDestRect, linesPerPage, numberOfLines;
    Handle           textHdl;
    SInt32            startOffset, endOffset;
    Str255           theString;

    TextFont(gFontNumber);
    TextSize(gFontSize);

    docStrucHdl = (docStructureHdl) GetWRefCon(windowRef);
    docEditTextStrucHdl = (*docStrucHdl)->editTextStrucHdl;
    pictureHdl = (*docStrucHdl)->pictureHdl;
```

```

destRect = (*docEditTextStrucHdl)->destRect;
heightDestRect = destRect.bottom - destRect.top;
linesPerPage = heightDestRect / (*docEditTextStrucHdl)->lineHeight;
numberOfLines = (*docEditTextStrucHdl)->nLines;

startOffset = (*docEditTextStrucHdl)->lineStarts[(pageNumber - 1) * linesPerPage];
if(pageNumber == numberOfPages)
    endOffset = (*docEditTextStrucHdl)->lineStarts[numberOfLines];
else
    endOffset = (*docEditTextStrucHdl)->lineStarts[pageNumber * linesPerPage];

pageEditTextStrucHdl = TENew(&destRect,&destRect);
textHdl = (*docEditTextStrucHdl)->hText;
HLock(textHdl);
TEInsert(*textHdl + startOffset,endOffset - startOffset,pageEditTextStrucHdl);
TEDispose(pageEditTextStrucHdl);

if(pageNumber == 1)
{
    SetRect(&pictureRect,destRect.left,destRect.top,
        destRect.left + ((*pictureHdl)->picFrame.right - (*pictureHdl)->picFrame.left),
        destRect.top + ((*pictureHdl)->picFrame.bottom - (*pictureHdl)->picFrame.top));
    DrawPicture(pictureHdl,&pictureRect);
}

MoveTo(destRect.left,pageRect.bottom - 25);
NumToString((SInt32) pageNumber,theString);
DrawString(theString);
}

// ***** doDrawPrintInfo

void doDrawPrintInfo(void)
{
    docStructureHdl docStrucHdl;
    OSStatus          osStatus = kPMNoError;
    PMRect            theRect;
    Str255             s2, s3;
    PMResolution       resolution;
    double             scale;
    PMOrientation       orientation;

    docStrucHdl = (docStructureHdl) GetWRefCon(gDocumentWindowRef);
    if((*docStrucHdl)->pageFormat == kPMNoPageFormat)
        return;

    HLock((Handle) docStrucHdl);

    MoveTo(20,25);
    TextFace(bold);
    DrawString("\pFrom PMPageFormat Object:");
    TextFace(normal);

```

```

PMGetAdjustedPaperRect((*docStrucHdl)->pageFormat,&theRect);
NumToString((SInt32) theRect.top,s2);
NumToString((SInt32) theRect.left,s3);
doDrawRectStrings("\pPaper Rectangle (top,left):",20,45,s2,190,45,s3);
NumToString((SInt32) theRect.bottom,s2);
NumToString((SInt32) theRect.right,s3);
doDrawRectStrings("\pPaper Rectangle (bottom,right):",20,60,s2,190,60,s3);

PMGetAdjustedPageRect((*docStrucHdl)->pageFormat,&theRect);
NumToString((SInt32) theRect.top,s2);
NumToString((SInt32) theRect.left,s3);
doDrawRectStrings("\pPage Rectangle (top,left):",20,75,s2,190,75,s3);
NumToString((SInt32) theRect.bottom,s2);
NumToString((SInt32) theRect.right,s3);
doDrawRectStrings("\pPage Rectangle (bottom,right):",20,90,s2,190,90,s3);

PMGetResolution((*docStrucHdl)->pageFormat,&resolution);
MoveTo(20,105);
DrawString("\pDrawing Resolution (Vertical):");
NumToString((SInt32) resolution.vRes,s2);
MoveTo(190,105);
DrawString(s2);
DrawString("\p dpi");
MoveTo(20,120);
DrawString("\pDrawing Resolution (Horizontal):");
NumToString((SInt32) resolution.hRes,s2);
MoveTo(190,120);
DrawString(s2);
DrawString("\p dpi");

PMGetScale((*docStrucHdl)->pageFormat,&scale);
MoveTo(20,135);
DrawString("\pScale:");
NumToString((SInt32) scale,s2);
MoveTo(190,135);
DrawString(s2);
DrawString("\p%");

PMGetOrientation((*docStrucHdl)->pageFormat,&orientation);
MoveTo(20,150);
DrawString("\pPage Orientation:");
MoveTo(190,150);
if(orientation == kPMPortrait)
    DrawString("\pPortrait");
else if(orientation == kPMLandscape)
    DrawString("\pLandscape");

if(gDrawPrintSettingsStuff)
{
    MoveTo(20,170);
    TextFace(bold);
    DrawString("\pFrom PMPrintSettings Object:");
    TextFace(normal);
}

```



```

    MoveTo(20,190);
    DrawString("\pFirst Page:");
    NumToString((SInt32) gFirstPage,s2);
    MoveTo(190,190);
    DrawString(s2);

    MoveTo(20,205);
    DrawString("\pLast Page:");
    NumToString((SInt32) gLastPage,s2);
    MoveTo(190,205);
    DrawString(s2);

    MoveTo(20,220);
    DrawString("\pNumber of Copies:");
    NumToString((SInt32) gCopies,s2);
    MoveTo(190,220);
    DrawString(s2);
}

HUnlock((Handle) docStrucHdl);
}

// ***** doDrawRectStrings

void doDrawRectStrings(Str255 s1,SInt16 x1,SInt16 y1,Str255 s2,SInt16 x2,SInt16 y2,Str255 s3)
{
    MoveTo(x1,y1);
    DrawString(s1);
    MoveTo(x2,y2);
    DrawString("\p(");
    DrawString(s2);
    DrawString("\p,");
    DrawString(s3);
    DrawString("\p)");
}

// ***** doErrorAlert

void doErrorAlert(OSStatus errorType)
{
    Str255 theString, errorString = "\pCarbon Printing Manager Error ";
    SInt16 itemHit;

    NumToString((SInt32) errorType,theString);
    doConcatPStrings(errorString,theString);

    StandardAlert(kAlertCautionAlert,errorString,NULL,NULL,&itemHit);
}

// ***** doConcatPStrings

void doConcatPStrings(Str255 targetString,Str255 appendString)
{
    SInt16 appendLength;

```

```

    appendLength = MIN(appendString[0],255 - targetString[0]);

    if(appendLength > 0)
    {
        BlockMoveData(appendString+1,targetString+targetString[0]+1,(SInt32) appendLength);
        targetString[0] += appendLength;
    }
}

// *****
// PrintDialogAppend.c
// *****

// ..... includes

#include "CarbonPrinting.h"

// ..... global variables

SInt32    gFirstAppendedItemNo;
PItemUPP gOldItemEvaluateFunctionUPP;

extern PMDialog    gPMDialog;
extern PItemUPP    gNewItemEvaluateFunctionUPP;
extern ModalFilterUPP gEventFilterUPP;
extern SInt16      gFontNumber;
extern SInt16      gFontSize;

// ***** initializationFunction

void initializationFunction(PMPrintSettings printSettings,PMDialog *pmDialog)
{
    OSStatus    osStatus = kPMNoError;
    DialogRef    dialogRef;
    Handle    ditlHdl;
    SInt16    numberOfExistingItems, numberOfMenuItems;
    MenuRef    menuRef;
    ControlRef    controlRef;
    Str255    itemName;

    *pmDialog = gPMDialog;

    osStatus = PMGetDialogPtr(*pmDialog,&dialogRef);

    if(osStatus == kPMNoError)
    {
        // ..... append DITL

        ditlHdl = GetResource('DITL',rPrintDialogAppendDITL);
        numberOfExistingItems = CountDITL(dialogRef);
        AppendDITL(dialogRef,ditlHdl,appendDITLBottom);
        gFirstAppendedItemNo = numberOfExistingItems + 1;
    }
}

```

```

// ..... create font menu and attach to popup button, set current font to first item

menuRef = NewMenu(mFont,NULL);
CreateStandardFontMenu(menuRef,0,0,0,NULL);
GetDialogItemAsControl(dialogRef,gFirstAppendedItemNo,&controlRef);
SetControlMinimum(controlRef,1);
numberOfMenuItems = CountMenuItems(menuRef);
SetControlMaximum(controlRef,numberOfMenuItems);
SetControlData(controlRef,kControlEntireControl,kControlIPopupButtonMenuRefTag,
    sizeof(menuRef),&menuRef);
GetMenuItemText(menuRef,1,itemName);
GetFNum(itemName,&gFontNumber);

// ..... set second radio button to on state and set current font size

GetDialogItemAsControl(dialogRef,gFirstAppendedItemNo + 2,&controlRef);
SetControlValue(controlRef,1);
gFontSize = 12;

// ..... switch fractional widths off

GetDialogItemAsControl(dialogRef,gFirstAppendedItemNo + 4,&controlRef);
SetControlValue(controlRef,0);
SetFractEnable(false);
}

if(osStatus == kPMNoError)
    osStatus = PMGetItemProc(*pmDialog,&gOldItemEvaluateFunctionUPP);
if(osStatus == kPMNoError)
    osStatus = PMSetItemProc(*pmDialog,gNewItemEvaluateFunctionUPP);

if(osStatus == kPMNoError)
    PMSetModalFilterProc(*pmDialog,gEventFilterUPP);

if(osStatus != kPMNoError)
    doErrorAlert(osStatus);
}

// ***** itemEvaluationFunction

void itemEvaluationFunction(DialogRef dialogRef,SInt16 itemHit)
{
    SInt16    localizedItemNo, controlValue;
    ControlRef controlRef;
    MenuRef   menuRef;
    Str255    itemName;

    localizedItemNo = itemHit - gFirstAppendedItemNo + 1;

    if(localizedItemNo > 0)
    {
        if(localizedItemNo == iPopupButton)

```

```

{
    GetDialogItemAsControl(dialogRef,gFirstAppendedItemNo,&controlRef);
    controlValue = GetControlValue(controlRef);
    GetControlData(controlRef,kControlEntireControl,kControlPopupMenuHandleTag,
        sizeof(menuRef),(Ptr) &menuRef,NULL);
    GetMenuItemText(menuRef,controlValue,itemName);
    GetFNum(itemName,&gFontNumber);
}
else if(localizedItemNo >= iRadioButton10pt && localizedItemNo <= iRadioButton14pt)
{
    GetDialogItemAsControl(dialogRef,gFirstAppendedItemNo + 1,&controlRef);
    SetControlValue(controlRef,0);
    GetDialogItemAsControl(dialogRef,gFirstAppendedItemNo + 2,&controlRef);
    SetControlValue(controlRef,0);
    GetDialogItemAsControl(dialogRef,gFirstAppendedItemNo + 3,&controlRef);
    SetControlValue(controlRef,0);

    GetDialogItemAsControl(dialogRef,itemHit,&controlRef);
    SetControlValue(controlRef,1);

    if(localizedItemNo == iRadioButton10pt)
        gFontSize = 10;
    else if(localizedItemNo == iRadioButton12pt)
        gFontSize = 12;
    else if(localizedItemNo == iRadioButton14pt)
        gFontSize = 14;
}
else if(localizedItemNo == iCheckboxFracWidths)
{
    GetDialogItemAsControl(dialogRef,gFirstAppendedItemNo + 4,&controlRef);
    SetControlValue(controlRef,!GetControlValue(controlRef));
    SetFractEnable(GetControlValue(controlRef));
}
}
else
{
    InvokePMItemUPP(dialogRef,itemHit,gOldItemEvaluateFunctionUPP);
}
}

// ***** eventFilter

Boolean eventFilter(DialogRef dialogRef,EventRecord *eventStrucPtr,SInt16 *itemHit)
{
    Boolean handledEvent;
    GrafPtr oldPort;

    handledEvent = false;

    if((eventStrucPtr->what == updateEvt) &&
        ((WindowRef) eventStrucPtr->message != GetDialogWindow(dialogRef)))
    {
        doUpdate(eventStrucPtr);
    }
}

```

```

else
{
    GetPort(&oldPort);
    SetPortDialogPort(dialogRef);

    handledEvent = StdFilterProc(dialogRef,eventStrucPtr,itemHit);

    SetPort(oldPort);
}

return handledEvent;
}

// *****

```

## Demonstration Program CarbonPrinting Comments

When the program is run, the user should

- Choose Page Setup... from the File menu, make changes in the Page Setup dialog, and observe the information, extracted from the PMPageFormat object, drawn in the window titled Some Printing Information.
- Choose Print... from the File menu, note the items added to the Print dialog, select the desired font, font size, and fractional widths setting using these items, and print the document.

The user should print the document several times using different page size, scaling, and orientation settings in the Page Setup dialog (noting the changed information in the Printing Settings window), and occasionally limiting the number of changes printed by changing the start-page and end-page settings in the Print dialog.

The window in which the “document” is displayed is titled Simulated Document because, in this demonstration, the document is not loaded from a file. Rather, a document is simulated using text from a 'TEXT' resource and a picture from a 'PICT' resource. This approach is used in order to keep that part of the source code not related to printing per se to a minimum. For the same reason, the (flattened) PMPageFormat object is not saved to the resource fork of a document file in this demonstration. (The demonstration program in Chapter 19 shows how to do this.)

## Printing.h

### defines

Constants are established for the resource IDs of a 'PICT' and 'TEXT' resources used for the printing demonstration, and for the 'DITL' resource containing the items to be appended to the

Print dialog. Five constants are established for the item numbers of the items in the 'DITL' resource. `kMargin` is used to set the margins for the printed page.

### **typedefs**

A handle to a structure of type `docStructure` will be stored in the Window object for the Simulated Document window. The fields of this structure will be assigned `PMPrintSession`, `PMPageFormat`, and `PMPrintSettings` objects, together with handles to the 'TEXT' and 'PICT' resources referred to above.

## **CarbonPrinting.c**

### **Global Variables**

`gFontNumber` will be assigned the current font number. `gFontSize` will be assigned the current font size. Both of these values can be changed by the user via the items added to the Print dialog.

`gNewItemEvaluateFunctionUPP` and `gEventFilterUPP` will be assigned a universal procedure pointer to, respectively, the item evaluation function and event filter function for the customized Print dialog. `gPMDialog` will be assigned a pointer to a `PMDialog` object for the customized Print dialog.

The last four variables are incidental to the demonstration, and will be used to store information to be displayed in the second window (titled Some Printing Information) created by the program.

### **main**

After the Simulated Document window is created, its font is set to Geneva 10 point and the global variables `gFontNumber` and `gFontSize` are set to reflect this. A document structure is then created and associated with the window. The three fields of the document structure which will be assigned Carbon Printing Manager objects are then initialized.

The Some Printing Information window is then created.

The call to `doGetDocument` displays the simulated document in the Simulated Document window.

Note that, in this program, error handling of all errors other than Carbon Printing Manager errors is somewhat rudimentary. The program simply exits.

### **doGetDocument**

`doGetDocument` creates a monostyled `TextEdit` structure, assigns the handle to this structure to the relevant field of the Simulated Document window's document structure, loads a 'TEXT' resource, and inserts it into a `TextEdit` structure. (The act of insertion causes the text to be

drawn on the screen.) A 'PICT' resource is then loaded and its handle assigned to the relevant field of the Simulated Document window's document structure. The call to `InvalWindowRect` invalidates the content region, generating an update event which, as will be seen, causes the picture to be drawn in the window.

`TextEdit` is not addressed until Chapter 21; however, to facilitate an understanding of the `TextEdit` aspects of this program, it is sufficient at this stage to understand that a monostyled `TextEdit` structure contains the following fields:

**DestRect** The destination rectangle into which text is drawn. The bottom of the destination rectangle can extend to accommodate the end of the text. In other words, you can think of the destination rectangle as bottomless.

**ViewRect** The rectangle within which text is actually displayed.

**HText** A handle to the actual text.

**TxFont** The font number of the font to be used,

**txSize** The size of the font in points.

**LineHeight** The vertical spacing, in pixels, of the lines of text.

**NLines** The total number of lines of text.

**LineStarts** An array with a number of elements corresponding to the number of lines of text. Each element contains the offset of the first character in each line.

Note that the destination and view rectangles were passed in the call to `TENew`, these rectangles having been defined in the preceding five lines of code.

### **doUpdateDocumentWindow**

As will be seen, two of the functions directly related to printing operations will change the values in the `TextEdit` structure's `destRect`, `txFont`, `txSize`, and `lineHeight` fields. The middle block of the `doUpdateDocumentWindow` code simply resets the values in these fields back to those that existed after `doGetDocument` was called, and then calls `TECalcText` to re-calculate the line starts and `TEUpdate` to draw the text.

The second block saves the values in the `TextEdit` structure's `destRect`, `txFont`, `txSize`, and `lineHeight` fields as they existed before the update event was received and the fourth block restores these settings. The last two lines redraw the picture in the window.

### **doMenuChoice**

If the user chose Page Setup... from the File menu, `doPageSetupDialog` is called to display the Page Setup dialog, handle user interaction within the dialog, and record the settings made by the user. If an error is returned, `doErrorAlert` is called to present an alert advising of the error number.



If the user chose Print... from the File menu, `doPrintSettingsDialog` is to display the Print dialog, handle user interaction within the dialog, and record the settings made by the user. If no error is returned, `doPrinting` is then called to perform the printing. If `doPrinting` returns an error, `doErrorAlert` is called to present an alert advising of the error number.

If `doPrintSettingsDialog` returns an error, `doPrinting` is not called and `doErrorAlert` is called to present an alert advising of the error number.

### **doCreateOrValidatePageFormat**

`doCreateOrValidatePageFormat` is the first of the major printing functions. It is called, as their first action, by `doPageSetUpDialog` and `doPrintSettingsDialog`—that is, whenever the user chooses Page Setup... or Print... from the File menu. The main purpose of this function is to create a `PMPageFormat` object, assign default parameter values to that object, and associate the object with the document's window or, if the object has previously been created, simply validate the existing object.

The call to `PMCreateSession` creates a printing session object.

If a `PMPageFormat` object is not currently assigned to the `pageFormat` field of the window's document structure, `PMCreatePageFormat` and `PMSessionDefaultPageFormat` are called to create a `PMPageFormat` object and assign default parameters to it. The object is then associated with the document's window by assigning the object to the relevant field of the window's document structure.

On the other hand, if a `PMPageFormat` object is currently assigned to the `pageFormat` field of the window's document structure, `PMSessionValidatePageFormat` is called to validate the object within the context of the current printing session.

If no errors occurred, the `PMPrintSession` object is assigned to the relevant field of the document window's document structure, otherwise both the `PMPrintSession` and `PMPageFormat` objects are released.

### **doPageSetUpDialog**

`doPageSetUpDialog` is called when the user chooses Page Setup... from the File menu. Its purpose is to present the Page Setup dialog and modify the page setup information stored in the `PMPageFormat` object associated with the document's window according to settings made by the user within the dialog.

The call to `doCreateOrValidatePageFormat` ensures that `PMPageFormat` and `PMPrintSession` objects have been created and assigned to the relevant field of the window's document structure. The call to `PMSessionPageSetupDialog` then presents the Page Setup dialog and handles all user interaction within the dialog. If the user clicks the OK push button to dismiss the dialog, the `PMPageFormat` object will be updated to reflect any changed settings made by the user. No updating occurs if the user clicks the Cancel push button to dismiss the dialog.

When the dialog has been dismissed, `PMRelease` is called to release the `PMPrintSession` object.

### **doPrintSettingsDialog**

`doPrintSettingsDialog` is called when the user chooses `Print...` from the `File` menu. Its main purpose is to create a `PMPrintSettings` object and associate it with the document's window, and present the `Print` dialog and modify the print settings information stored in the `PMPrintSettings` object according to changed settings made by the user within the dialog.

The call to `doCreateOrValidatePageFormat` ensures that `PMPageFormat` and `PMPrintSession` objects have been created and assigned to the relevant field of the window's document structure. The call to `PMCreatePrintSettings` then creates a `PMPrintSettings` object.

The call to `PMSetJobNameCFString` sets the print job name used by the printing system. `PMSessionDefaultPrintSettings` is then called to assign default parameter values (number of copies, page range, and so on) to the `PMPrintSettings` object, following which the `PMPrintSettings` object is assigned to the relevant field of the document window's document structure.

The next block executes only if the program is running on Mac OS X. `PMSetPageRange` sets the valid range of pages that can be printed to 1–32000. (If the user enters values outside this range in the `Print` dialog, the Carbon Printing Manager displays an “out-of-range” alert.) The next two calls set the default first and last page numbers to be drawn in the relevant edit text fields in the `Print` dialog. Note that, if `kPMPrintAllPages` is passed in `PMSetLastPage`'s last parameter, the `All` radio button in the `Print` dialog will be selected when the dialog is displayed.

The `Print` dialog to be presented is to be customized. Accordingly, the first three lines inside the next if block create universal procedure pointers for the initialization, item evaluation, and event filter functions contained in the source code file `PrintDialogAppend.c`.

`PMSessionPrintDialogInit` is called to initialize a custom `Print` dialog. On return, the global variable `gPMDialog` contains a pointer to an initialized `PMDialog` object, ready for customization. This pointer is assigned to a global variable because the `PMSessionPrintDialogMain` function does not include a parameter for passing this `PMDialog` object to the dialog initialization function.

`PMSessionPrintDialogMain` presents the customized `Print` dialog, the universal procedure pointer to the initialization function being passed in the fifth parameter.

If the user clicked the `Print` push button, when `PMSessionPrintDialogMain` returns, the `PMPrintSettings` object will contain information on the settings displayed in the `Print` dialog (except for the settings in the customized section of the dialog).

If an error occurred, or if the user clicked the `Cancel` push button in the `Print` dialog, the `PMPrintSettings` and `PMPrintSession` objects are released and disassociated from the window.

In addition, within the function `doMenuChoice`, the call to the function `doPrinting` will not occur.

### **doPrinting**

`doPrinting` contains the printing loop.

After the current graphics port is saved for later restoration, `PMGetFirstPage` and `PMGetLastPage` are called to get the first and last page to print, as set in the Print dialog.

The next block is incidental to the demonstration, simply storing the first page, last page, and number of copies information retrieved from the `PMPrintSettings` object in global variables so that they can later be drawn in the Some Printing Information window.

`PMGetAdjustedPageRect` is then called to get the page rectangle, taking account of page orientation setting, scale setting, and drawing resolution. The double values in the fields of this `PMRect` structure are assigned to the (`SInt16`) fields of a normal `Rect` structure before that rectangle is passed to a function which calculates the actual number of pages in the document.

If the calculated actual number of pages is less than the value returned by the call to `PMGetLastPage`, the value in the variable `lastPage` is changed to the calculated number of pages.

For Mac OS X only, `PMSetFirstPage` and `PMSetLastPage` are called to set the first and actual last page in the `PMPrintSettings` object. This ensures that the page number information displayed in the progress dialog invoked during printing will be correct.

The printing loop is now entered. The first action is to call `PMSessionBeginDocument` to establish a graphics context (`PMPrintContext` object) for imaging the document. As will be seen, a function exists to obtain the graphics port (that is, the printing port) associated with this object.

The while loop spools all of the pages in the document, relying on the Carbon Printing Manager to print the correct page range. Within the loop

- `GetPort` is called to save the current graphics port.
- `PMSessionBeginPage` is called to initialize the printing port. (Note that, for Mac OS 8/9, this function may also be used to initialize a scaling rectangle for drawing the page, in which case the address of a `PMRect` passed in the last parameter will be passed to the printer driver.)
- `PMSessionGetGraphicsContext` is called to obtain the current printing port, and `SetPort` is called to set this port as the current port.
- `doDrawPage` is called to draw the specified page in the current printing port.
- `SetPort` is called to restore the saved graphics port.
- `PMSessionEndPage` is called to print the page.

After the pages have been spooled, `PMSessionEndDocument` is called to close the printing port. On Mac OS X, this call also dismisses the progress dialog.

Note that the printing loop does not have to concern itself with the number of copies, since this is handled automatically by the Carbon Printing Manager.

Finally, the `PMPrintSettings` and `PMPrintSession` objects are released and disassociated from the document's window, and the graphics port saved at function entry is restored.

### **doCalcNumberOfPages**

`doCalcNumberOfPages` is called by `doPrinting` to calculate the actual number of pages in the document based on the page rectangle passed to it.

The first line retrieves the handle to the specified window's document structure. The next two lines set the current font and font size to the font number and size set by the user in the appended items in the Print dialog. This allows the call to `GetFontInfo` to retrieve some relevant information about the font.

The next four lines change the values in the `txFont`, `txSize`, and `lineHeight` fields of the `TextEdit` structure whose handle is stored in the window's document structure. (Note that information obtained by the `GetFontInfo` call is used to calculate line height.)

The next three lines change the rectangle stored in the `destRect` field of the `TextEdit` structure to one equal to the received page rectangle less 180 pixels in width and 270 pixels in height. (This smaller rectangle is centered on the page rectangle both laterally and vertically.)

With these changes made, `TECalcText` is called to recalculate the line starts. In addition to changing the values in the `lineStarts` array in the `TextEdit` structure, this call will assign the new total number of lines to the `nLines` field.

The matter of the actual calculation of the number of pages now follows. The first line in the last block gets the height of the previously defined destination rectangle. The next line calculates how many lines of text will fit into that height. The third line then calculates the total number of rectangles (and thus the number of pages) required to accommodate the whole of the text.

### **doDrawPage**

`doDrawPage` is called by `doPrinting` to draw a specified page in the printing graphics port.

The first action is to set the printing graphics port's font and font size to the font number and size set by the user in the appended items in the Print dialog.

The next block retrieves a handle to the specified window's document structure, allowing handles to the `TextEdit` structure and picture to be retrieved.

In the next block, the destination rectangle in the `destRect` field of the `TextEdit` structure is assigned to a local variable, the height of this rectangle is assigned to a local variable, the lines per page is calculated and assigned to a local variable, and the total number of lines is assigned to a local variable.

In the next block, the first line gets the starting offset, that is, the offset from the first character in the block of text to the first character in the first line of text for the specified page number. The next four lines get the ending offset, that is, the offset to the last character in the last line of text for the specified page.

The call to `TENew` creates a new monostyled `TextEdit` structure with the previously defined destination rectangle passed in both the destination and view rectangle parameters. The following line gets a handle to the actual text in the `TextEdit` structure. This handle is then locked preparatory to a call to `TEInsert`. Using the offsets previously calculated, `TEInsert` then inserts the text for the current page into the newly created `TextEdit` structure, an action which causes that text to be drawn in the printing graphics port. The text having been drawn, the `TextEdit` structure is then disposed of.

If this is the first page, the next block draws the previously loaded picture at the top left of the previously defined rectangle.

The last three lines draw the page number at the bottom left of the original page rectangle.

### **doDrawPrintInfo and doDrawRectStrings**

`doDrawPrintInfo` is called when an update event is received for the Some Printing Information window. Carbon Printing Manager accessor functions are then used to obtain information from the `PMPageFormat` object associated with the document's window and draw that information in the window. In addition, information retrieved from the `PMPrintSettings`, and saved to global variables within the function `doPrinting`, is drawn in the window if the global variable `doDrawPrintSettingsStuff` is set to true.

### **doErrorAlert**

`doErrorAlert` is called when the printing functions return an error other than the "user cancelled" error. An alert showing the error code is displayed.

## **PrintDialogAppend.c**

### **initializationFunction**

Recall that, in the function `doPrintSettingsDialog`, a universal procedure pointer to `initializationFunction` was passed in the `myInitProc` parameter of the `PMSessionPrintDialogMain` call. `PMSessionPrintDialogMain` thus calls this function.

Recall also that the pointer to the initialized `PMDialog` object was assigned to a global variable (`gPMDialog`) because the `PMSessionPrintDialogMain` function does not include a parameter

for passing a `PMDialog` object to a dialog initialization function. At the first line, the pointer to the `PMDialog` object is copied to the initialization function's formal parameter `pmDialog`.

The call to `PMGetDialogPtr` gets a reference to the Print dialog dialog object.

The DITL to be appended to the dialog contains the following items:

- A pop-up menu for font selection
- Three radio buttons for font size selection
- A checkbox for selecting fractional widths on or off
- A primary group box (text title variant)

`GetResource` loads the specified 'DITL' resource and gets a handle to it. `CountDITL` counts the current number of items in the Print dialog. `AppendDITL` then appends the new items to the dialog. For some printers on Mac OS 8/9, this causes the dialog to expand downwards to accommodate the added items. For others (for, example, the LaserWriter 8), and on Mac OS X, the result of the `AppendDITL` call is that a pane is created for the items and the name of the application is inserted into the menu of a pop-up group box. When the item containing the application's name is chosen from the pop-up menu, the pane is displayed and the appended items are accessible.

The global variable `gFirstAppendedItemNo` is then assigned the item number in the new Print dialog item list of the first appended item (the pop-up menu button). This will be required by the function `itemEvaluationFunction`.

The next block calls `CreateStandardFontMenu` to create the menu for the pop-up menu button, which is then assigned to the pop-up menu button by `SetControlData`. Note that the font number for the first item in the menu is assigned to the global variable `gFontNumber`.

The next block selects the second radio (12pt) button and sets the global variable `gFontSize` to 12. The next block unchecks the checkbox and sets fractional widths to off.

The printer driver's item evaluation function will be called upon by the item evaluation function (`itemEvaluationFunction`) to handle mouse-downs in the Print dialog's standard items. Accordingly, `PMGetItemProc` is called to assign the universal procedure pointer to the driver's evaluation function to a global variable for later use. The call to `PMSetItemProc` makes `itemEvaluationFunction` the current item evaluation function.

Finally, the call to `PMSetModalFilterProc` makes the application-defined (callback) function `eventFilter` the event filter function for the Print dialog.

### **itemEvaluationFunction**

`itemEvaluationFunction` handles item hits in the Print dialog. The item number of the item hit is received in the second parameter.



At the first line, the item number of the item hit is “localized”. This means that, for example, the localized item number of the pop-up menu button will be 1. In other words, if the localized item number is greater than 0, it will be the item number of one of the appended items; otherwise, it will be the item number of one of the Print dialog’s standard items.

If the localized item number is greater than 0, and if it is the localized item number for the pop-up menu button, the control’s value (that is, the menu item number) is retrieved. `GetMenuItemText` is called to get the text of the menu item, and `GetFNum` is called to get the font number for this font and assign it to the relevant global variable.

If the localized item number is the localized item number for one of the radio buttons, all radio buttons are unchecked, the radio button hit is checked, and the global variable which holds the current text size is assigned the appropriate value. If the localized item number is the localized item number for the checkbox, the current value of that control is flipped and `SetFractEnable` is called to set fractional widths on or off as appropriate.

If the localized item number is 0 or less, the item must be one of the Print dialog’s standard items. In this case, the printer driver’s item evaluation function is called upon to handle the item hit.

### **eventFilter**

`eventFilter` is identical to the custom event filter for modal dialogs introduced in Chapter 8. The use of a the event filter is optional. Its use in this program simply allows the Print dialog, together with windows belonging to background applications, to receive update events (required only on Mac OS 8/9).

The Page Setup and Print dialogs in this demonstration program are application-modal. This is because the `AppendDITL` method used to customize the Print dialog prevents that dialog from being created as a window-modal (sheet) dialog. The basic modifications required to cause the dialogs to be window-modal are as follows:

- Display the Print dialog using the function `PMSessionPrintDialog` and eliminate all code relating to dialog customization.
- Immediately before the calls to `PMSessionPageSetupDialog` and `PMSessionPrintDialog`, call the function `PMSessionUseSheets`, passing the parent window’s reference in the `documentWindow` parameter and a universal procedure pointer to an application-defined (callback) function in the `sheetDoneProc` parameter.
- Add two application-defined (callback) functions that perform the actions required immediately following the dismissal of the dialogs, and modify the existing post-dismissal code accordingly.



# More on Windows

## CHAPTER

# 16

## IN THIS CHAPTER

- Introduction 848
- Floating Windows 848
- Utility and Toolbar Windows 850
- Window Proxy Icons 850
- Window Path Pop-Up Menus 853
- Transitional Window Animation and Sounds 854
- Creating and Storing Windows 854
- Accessing Window Information 858
- Moving and Positioning Windows 858
- Associating Data with Windows 861
- Adding To and Removing From the Update Region 861
- Setting Content Region Color and Pattern 862
- Window Scrolling 862
- The Window Menu 863
- Live Window Resizing 863
- Main Constants, Data Types, and Functions 864
- Demonstration Program Windows2 Listing 867
- Demonstration Program Windows2 Comments 883

## Introduction

As stated in Chapter 4, Mac OS 8.5 introduced a number of new features and associated system software functions to the Window Manager. The new functions associated with zooming and re-sizing windows were addressed in Chapter 4. This chapter addresses the remaining additional features, which include:

- Support for
  - Floating windows.
  - Window proxy icons.
  - Window path pop-up menus.
  - Transitional window animations and sounds.
- New functions for
  - Creating and storing windows.
  - Accessing window information.
  - Moving and positioning windows.
  - Associating data with a window.
  - Adding and removing rectangles and regions to and from a window's update region.
  - Setting the color or pattern of a window's content region.

This chapter also addresses additional features introduced with Carbon and live window resizing introduced with Mac OS X.

## Floating Windows

Floating windows are windows that stay in front of all of an application's document windows. They are typically used to display tool, pattern, color, and other choices to be made available to the user. Examples of floating windows are shown in Fig 1.

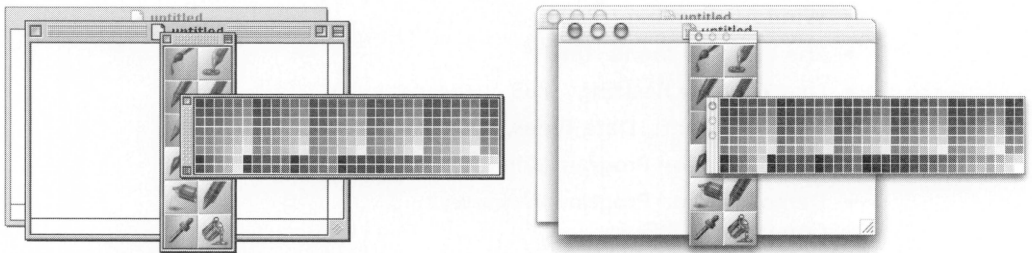


FIG 1 - FLOATING WINDOWS

In terms of front-to-back ordering of onscreen objects, floating windows, unlike document windows, are all basically equal. Unless they actually overlap each other, there is no visual cue of any front-to-back ordering as there is with normal windows (see Fig 1). Because of this equality, floating windows almost always appear in the active state. The exception is when a modal or movable modal dialog or alert is presented to the user. When this occurs, the appearance of all floating windows changes to reflect the inactive state.

## Floating Window Types

The 16 available window types for floating windows are shown in Figs 4 and 5 in Chapter 4.

## Opening, Closing, Showing, and Hiding Floating Windows

Floating windows may be created using the function `CreateNewWindow` (see below) with the constant `kFloatingWindowClass` passed in the `windowClass` parameter.

When a floating window is created, it should remain open until the application is closed, and your application should provide the user with a means to hide or show the window as and when required. Ordinarily, it should do this by providing an item in an appropriate menu that allows the user to toggle the window between the hidden and showing states.

A floating window's close box/button should simply hide the window, not close it. For that reason, the close box/button in floating windows should be conceived of as a "hide" box/button rather than as a close box/button.

Floating windows should be hidden when the application receives a suspend event. This is to avoid user confusion arising from one application's floating windows being visible when another application is in the foreground. The application's floating windows should be shown again only when the application receives a subsequent resume event.

### Carbon Note

In Carbon applications, floating windows are hidden and shown automatically on suspend and resume events. It is thus not necessary for Carbon applications to call `HideFloatingWindows` and `ShowFloatingWindows`.

## Functions Relating to Floating Windows

The following function is relevant to floating windows:

<i>Function</i>	<i>Description</i>
<code>AreFloatingWindowsVisible</code>	Indicates whether an application's floating windows are visible.

## Utility and Toolbar Windows

Carbon introduced the **utility window** (a system-wide floating window which floats above all other windows) and the **toolbar window**, which floats above all document windows in an application but below floating windows. (See Window Class Constants, later in this chapter.)

## Window Proxy Icons

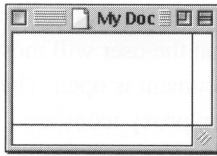
Window proxy icons are small icons displayed in the title bar of document windows. Ordinarily, a specific document file is associated with a specific window, and the proxy icon serves as a proxy for the document file's icon in the Finder.

Proxy icons

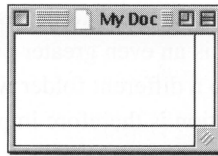
- May be dragged, in the same way that the document's icon in the Finder may be dragged, so as to move or copy the document file.
- Provide visual feedback to the user on the current state of the document. For example, when the document has unsaved changes, your application should cause the proxy icon to be displayed in the disabled state, thus preventing the user from dragging it. (Unsaved documents should not be capable of being moved or copied.)
- Provide visual feedback to the user indicating that the document window is a valid drag-and-drop target. In this case, your application should cause the proxy icon to appear in the highlighted state.

Fig 2 shows a typical window proxy icon for a document in the enabled, disabled, and highlighted states.

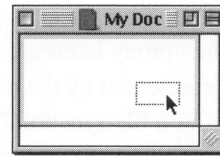
In Fig 2, note that in the drag and drop operation depicted at the right, the window's content area is highlighted along with the proxy icon. Applications typically call the Drag Manager function `ShowDragHilite` to indicate, with this highlighting, that a window is a valid drag-and-drop target. `ShowDragHilite` and `HideDragHilite` highlight and unhighlight the proxy icon as well as the content area.



PROXY ICON IN ENABLED  
STATE (DOCUMENT HAS NO  
UNSAVED CHANGES)



PROXY ICON IN DISABLED  
STATE (DOCUMENT HAS  
UNSAVED CHANGES)



PROXY ICON IN HIGHLIGHTED  
STATE (OS 8/9 ONLY) (WINDOW  
IS VALID DRAG-&-DROP TARGET)

FIG 2 - WINDOW PROXY ICONS

## Changing the State of a Proxy Icon

Applications typically keep track of the modification state of a document so as to inform users that they have made changes to the document which they might wish to save before closing the document's window, for example. When a document has unsaved changes, your application should call `SetWindowModified` with `true` passed in the `modified` parameter to cause the proxy icon to appear in the disabled state. (On Mac OS X, this is accompanied by a dot appearing in the middle of the close button.) When the changes have been saved, your application should call `SetWindowModified` with `false` passed in the `modified` parameter to cause the proxy icon to appear in the enabled state.

## Handling Mouse-Down Events in a Window Proxy Icon

When a mouse-down event occurs in your application's window, and when `FindWindow` returns the `inProxyIcon` result code, your application should simply call `TrackWindowProxyDrag`. `TrackWindowProxyDrag` handles all aspects of the drag process while the user drags the proxy icon.

## Proxy Icons and File Synchronization Functions

It is always possible that, while a document file is open, the user may drag its Finder icon to another folder (including the Trash) or change the name of the file via the Finder icon. The application itself has no way of knowing that this has happened and will assume, unless it is informed otherwise, that the document's file is still at its original location with its original name. For this reason applications often include a frequently called **file synchronization function**, which synchronizes the application with the actual current location (and name) of its currently open document files.



A document's proxy icon is much more prominent to the user than the document's Finder icon. Thus, when proxy icons are used, there is an even greater possibility that the user will move the file represented by the proxy icon to a different folder while the document is open. The provision of a file synchronization function is therefore imperative when proxy icons are implemented.

File synchronization functions are addressed in Chapter 18.

## Functions Relating to Window Proxy Icons

The following functions are relevant to window proxy icons:

<i>Function</i>	<i>Description</i>
<code>SetWindowProxyCreatorAndType</code>	Sets the proxy icon for a window that has no associated file.  New untitled windows should have a proxy icon so as to be consistent, in terms of appearance, with other windows.
<code>SetWindowProxyFSSpec</code>	Associates a file with a window using a file system specification (FSSpec) structure, thus establishing a proxy icon for the window.
<code>GetWindowProxyFSSpec</code>	Gets a file system specification (FSSpec) structure for the file associated with a window.
<code>SetWindowProxyAlias</code>	Associates a file with a window using a handle to an AliasRecord structure, thus establishing a proxy icon for the window.
<code>GetWindowProxyAlias</code>	Gets alias data for the file associated with a window.
<code>SetWindowProxyIcon</code>	Overrides the default proxy icon for a window.
<code>GetWindowProxyIcon</code>	Gets a window's proxy icon.
<code>RemoveWindowProxy</code>	Dissociates a file from a window.
<code>TrackWindowProxyDrag</code>	Handles all aspects of the drag process when a proxy icon is dragged by the user.

Note that `SetPortWindowPort` (or `SetPort`) should be called to set the relevant window's graphics port as the current port before calling `SetWindowProxyCreatorAndType`, `SetWindowProxyFSSpec`, `SetWindowProxyAlias`, and `SetWindowProxyIcon`.

## Window Path Pop-Up Menus

If your application supports window path pop-up menus, when the user presses the Command key and clicks a window's title, your window displays a pop-up menu containing a standard file system path. The pop-up menu allows the user to open windows for folders along the file system path. An example of a window path pop-up menu is shown in Fig 3.

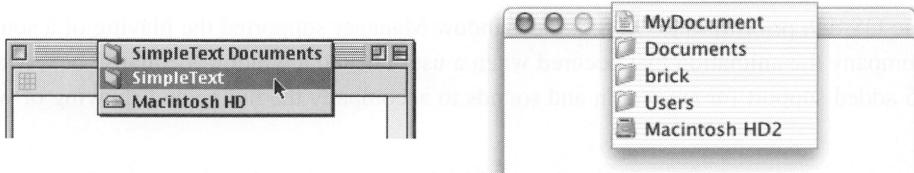


FIG 3 - WINDOW PATH POP-UP MENUS

## Displaying and Handling a Window Path Pop-Up Menu

The proxy icon region overlays the title text region which, in turn, overlays the drag region (see Fig 4). Your application must be prepared to respond to a Command-click in either region.

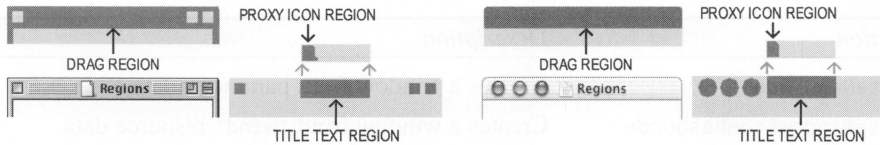


FIG 4 - DRAG, TITLE TEXT, AND PROXY ICON REGIONS

When `FindWindow` returns the `inProxyIcon` part code, and `TrackWindowProxyDrag` returns `errUserWantsToDragWindow`, your application should proceed on the assumption that the `inDrag` part code was returned by `FindWindow`.

When `FindWindow` returns the `inDrag` part code, your application should call `IsWindowPathSelectClick` to determine whether the mouse-down event should activate the window path pop-up menu. If `IsWindowPathSelectClick` returns `true`, `WindowPathSelect` should be called to display the menu.



If the user chooses a menu item for a folder, your application must ensure that the associated window is visible by calling a function that makes the Finder the frontmost process.

Window path pop-up menus are demonstrated at the demonstration program associated with Chapter 18.

## Transitional Window Animation and Sounds

On Mac OS 8/9, prior to Mac OS 8.5, the Window Manager supported the playing of a sound to accompany the animation that occurred when a user clicked a window's collapse box. Mac OS 8.5 added support for animation and sounds to accompany the hiding and showing of windows.

The function `TransitionWindow` may be used in lieu of the older functions `HideWindow` and `ShowWindow` to hide and show windows. `TransitionWindow` causes a transitional animation to be displayed, a transitional sound to be played (on Mac OS 8/9), and the necessary update and activate events to be generated.

## Creating and Storing Windows

Mac OS 8.5 introduced the following functions for creating and storing windows:

<i>Function</i>	<i>Description</i>
<code>CreateNewWindow</code>	Creates a window from parameter data.
<code>CreateWindowFromResource</code>	Creates a window from 'wind' resource data.
<code>CreateWindowFromCollection</code>	Creates a window from collection data.
<code>StoreWindowIntoCollection</code>	Stores data describing a window into a collection.

Use of the last three of these functions requires a basic understanding of **collections**, **flattened collections** and **'wind' resources**.

## Collections, Flattened Collections, and 'wind' Resources

### Collections

A **collection object** (or, simply, a collection) is an abstract data type that allows you to store multiple pieces of related information.

A collection is like an array in that it contains a number of individually accessible items. However, unlike an array, a collection allows for a variable number of data items and variable-size items. A collection is also similar to a database, in that you can store information and retrieve it using a variety of search mechanisms.

The internal structure of a collection is private. This means that you must store information in a collection and retrieve information from it using Collection Manager functions.

Your application can store a window in a collection using the function `StoreWindowIntoCollection`. (This applies to any window, not just windows created using the new functions introduced with Mac OS 8.5.) Data associated with the window (for example, text) may also be stored in the same collection.

Using the function `CreateWindowFromCollection`, you can create a window from collection data. Note that `CreateWindowFromCollection` creates the window invisibly. After creating the window, you must call the function `TransitionWindow` to display the window.

## Flattened Collections

Using the Collection Manager, your application can create a flattened collection from a collection. A flattened collection is a stream of address-independent data.

## The 'wind' Resource

The 'wind' resource consists of an extensible flattened collection. Using the Resource Manager, your application can store a flattened collection, consisting of a window and its data, into a 'wind' resource.

Using the function `CreateWindowFromResource`, you can create a window from a 'wind' resource. Note that `CreateWindowFromResource` creates the window invisibly. After creating the window, you must call the function `TransitionWindow` to display the window.

## The CreateNewWindow Function

The `CreateNewWindow` function creates a window based on the class and attributes you specify in the `windowClass` and `attributes` parameters. The following constants may be passed in these parameters.

## Window Class Constants

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kAlertWindowClass</code>	1L	Alert window.
<code>kMovableAlertWindowClass</code>	2L	Movable alert window.
<code>kModalWindowClass</code>	3L	Modal dialog window.
<code>kMovableModalWindowClass</code>	4L	Movable modal dialog window.
<code>kFloatingWindowClass</code>	5L	Floating window.
<code>kDocumentWindowClass</code>	6L	Document window or modeless dialog window.  Note: The Window Manager assigns this class to windows created using the older window creation functions.
<code>kUtilityWindowClass</code>	8L	System-wide floating window.
<code>kHelpWindowClass</code>	10L	Help window.
<code>kSheetWindowClass</code>	11L	Sheet window. (Mac OS X only.)
<code>kToolbarWindowClass</code>	12L	Toolbar windows (above documents, below floating windows).
<code>kPlainWindowClass</code>	13L	Plain window (in document layer).
<code>kOverlayWindowClass</code>	14L	Transparent window that allows “screen” drawing via CoreGraphics. (Mac OS X only.)
<code>kSheetAlertWindowClass</code>	15L	Sheet windows for alerts. (Mac OS X only.)
<code>kAltPlainWindowClass</code>	16L	Alternate plain window (in document layer).
<code>kAllWindowsClasses</code>	0xFFFFFFFF	For use with <code>GetFrontWindowOfClass</code> , <code>FindWindowOfClass</code> , <code>GetNextWindowOfClass</code> (see below).

## Window Attribute Constants

<i>Constant</i>	<i>Bit</i>	<i>Description</i>
<code>kWindowNoAttributes</code>	0L	No attributes.
<code>kWindowCloseBoxAttribute</code>	1L << 0	Has close box/button.
<code>kWindowHorizontalZoomAttribute</code>	1L << 1	Has horizontal zoom box.
<code>kWindowVerticalZoomAttribute</code>	1L << 2	Has vertical zoom box.
<code>kWindowFullZoomAttribute</code>	<code>kWindowVerticalZoomAttribute</code>   <code>kWindowHorizontalZoomAttribute</code>	Has full zoom box/zoom button.
<code>kWindowCollapseBoxAttribute</code>	1L << 3	Has a collapse box/minimize button.
<code>kWindowResizableAttribute</code>	1L << 4	Has size box/resize control.
<code>kWindowSideTitlebarAttribute</code>	1L << 5	Has side title bar. This attribute may be applied only to floating windows.
<code>kWindowNoUpdatesAttribute</code>	1L << 16	Does not receive update events.
<code>kWindowNoActivatesAttribute</code>	1L << 17	Does not receive activate events.
<code>kWindowNoShadowAttribute</code>	1L << 21	No shadow. (Mac OS X only.)
<code>kWindowHideOnSuspendAttribute</code>	1L << 24	Window is automatically hidden and shown on, respectively, suspend and shown on resume. (Carbon only.)
<code>kWindowStandardHandlerAttribute</code>	1L << 25	Window should have standard window event handler installed. (Carbon only.)
<code>kWindowHideOnFullScreenAttribute</code>	1L << 26	Window is automatically hidden during fullscreen mode. (Carbon only.)
<code>kWindowInWindowMenuAttribute</code>	1L << 27	Window is automatically tracked in Window menu. (Document windows are automatically given this attribute.)
<code>kWindowLiveResizeAttribute</code>	1L << 28	Window supports live resizing. (Mac OS X only.)
<code>kWindowStandardDocumentAttributes</code>	<code>kWindowCloseBoxAttribute</code>   <code>kWindowFullZoomAttribute</code>   <code>kWindowCollapseBoxAttribute</code>   <code>kWindowResizableAttribute</code>	Has standard document window attributes, that is, close box, full zoom box, collapse box, and size box.
<code>kWindowStandardFloatingAttributes</code>	<code>kWindowCloseBoxAttribute</code>   <code>kWindowCollapseBoxAttribute</code>	Has standard floating window attributes, that is, close box and collapse box.

Note that `CreateNewWindow` creates the window invisibly. After creating the window, you must call the `TransitionWindow` function to display the window.

## Accessing Window Information

The following functions are provided for accessing window information:

<i>Function</i>	<i>Description</i>
<code>GetWindowClass</code>	Obtains the class of a window.
<code>GetWindowAttributes</code>	Obtains the attributes of a window.
<code>ChangeWindowAttributes</code>	Change the attributes of a window.
<code>IsValidWindowPtr</code>	Reports whether a reference is a valid window reference.
<code>FrontNonFloatingWindow</code>	Returns a reference to the frontmost visible window that is not a floating window.
<code>FindWindowOfClass</code>	A version of the <code>FindWindow</code> function that limits the search to windows of one particular class. If a window is found at the specified point, but is not of the specified class, <code>errWindowNotFound</code> is returned and the value of <code>outWindow</code> is set to <code>NULL</code> .
<code>GetFrontWindowOfClass</code>	A more explicit version of the <code>FrontWindow</code> and <code>FrontNonFloatingWindow</code> functions.
<code>GetNextWindowOfClass</code>	A more explicit version of the function <code>GetNextWindow</code> .

## Moving and Positioning Windows

### Moving Windows

When your application wishes to move a window for a reason other than a user-instigated drag, it should use the function `MoveWindowStructure` or the earlier function `MoveWindow`.

`MoveWindow` repositions a window's content region, whereas `MoveWindowStructure` repositions a window's structure region.

The `SetWindowBounds` function provides a means to set the size of a window in addition to simply repositioning it. The size and position of the window are specified in a rectangle passed in the `globalBounds` parameter. In addition, you may specify whether this rectangle represents the bounds of the content region or the bounds of the structure region by passing either `kWindowContentRgn` or `kWindowStructureRgn` in the `regionCode` parameter. The sister function `GetWindowBounds` obtains the size and position of the bounding rectangle of the specified window region.

## Positioning Windows

Generally speaking, a new window should be placed on the desktop where the user expects it to appear. For new document windows, this usually means just below and to the right of the last document window in which the user was working, although this is not necessarily the case on systems with multiple monitors.

The `RepositionWindow` function allows you to position a window relative to another window or a display screen. The required window positioning method may be specified by passing one of the following constants in the method parameter.

### Window Positioning Constants

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kWindowCenterOnMainScreen</code>	<code>0x00000001</code>	The window is centered on the screen that contains the menu bar.
<code>kWindowCenterOnParentWindow</code>	<code>0x00000002</code>	The window is centered on the parent window. If the window is wider than the parent window, its left edge is aligned with the parent window's left edge.
<code>kWindowCenterOnParentWindowScreen</code>	<code>0x00000003</code>	The window is centered on the screen containing the parent window.
<code>kWindowCascadeOnMainScreen</code>	<code>0x00000004</code>	The window is placed just below the menu bar at the left edge of the main screen. Subsequent windows are placed relative to the first window in such a way that the frame of the preceding window remains visible behind the current window.

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kWindowCascadeOnParentWindow</code>	<code>0x00000005</code>	The window is placed below and to the right of the upper-left corner of the parent window in such a way that the frame of the parent window remains visible behind the current window.
<code>kWindowCascadeOnParentWindowScreen</code>	<code>0x00000006</code>	The window is placed just below the menu bar at the left edge of the screen that contains the parent window. Subsequent windows are placed on the screen relative to the first window in such a way that the frame of the preceding window remains visible behind the current window.
<code>kWindowAlertPositionOnMainScreen</code>	<code>0x00000007</code>	The window is centered horizontally and positioned vertically, on the screen that contains the menu bar in such a way that about one-fifth of the screen is above it.
<code>kWindowAlertPositionOnParentWindow</code>	<code>0x00000008</code>	The window is centered horizontally and positioned vertically in such a way that about one-fifth of the parent window is above it.
<code>kWindowAlertPositionOnParentWindowScreen</code>	<code>0x00000009</code>	The window is centered horizontally and positioned vertically in such a way that about one-fifth of the screen containing the parent window is above it.



These constants should not be confused with the older positioning specification constants (see Chapter 4), and should not be used where those older constants are required (for example, in 'WIND', 'DLOG', and 'ALRT' resources, and in the StandardAlert function).

## Associating Data with Windows

The function SetWRefCon has always allowed your application to associate a pointer to data with a reference to a window object. An alternative method of associating data with windows is to use the standard mechanism introduced with Mac OS 8.5. (Both methods, incidentally, are Carbon-compliant.)

The following functions are provided for associating data with windows:

Function	Description
SetWindowProperty	Associates data with a window.
GetWindowProperty	Gets data associated with a window.
GetWindowPropertySize	Gets the size of data associated with a window.
RemoveWindowProperty	Removes data associated with a window.

## Adding To and Removing From the Update Region

The Mac OS 8.5 Window Manager provided enhanced functions for manipulating the update region. Unlike their pre-Mac OS 8.5 counterparts (InvalRect, InvalRgn, ValidRect, and ValidRgn, which are not included in the Carbon API), the new functions allow the window on which they operate to be explicitly specified, meaning that they do not require the graphics port to be set prior to their use.

The following are the functions for manipulating the update region:

Function	Description
InvalWindowRect	Adds a rectangle to the window's update region.
InvalWindowRgn	Adds a region to the window's update region.
ValidWindowRect	Removes a rectangle from the window's update region.
ValidWindowRgn	Removes a region from the window's update region.

## Setting Content Region Color and Pattern

The following functions set the color or pattern of a window's content region:

<i>Function</i>	<i>Description</i>
<code>SetWindowContentColor</code>	Sets the color to which a window's content region is redrawn on receipt of an update event.
<code>GetWindowContentColor</code>	Gets the color to which a window's content region is redrawn.
<code>SetWindowContentPattern</code>	Sets the pattern to which a window's content region is redrawn on receipt of an update event.
<code>GetWindowContentPattern</code>	Gets the pattern to which a window's content region is redrawn.

These functions do not affect the graphics port's background color or pattern.

## Window Scrolling

The following functions scroll pixels within a window:

<i>Function</i>	<i>Description</i>
<code>ScrollWindowRect</code> <code>ScrollWindowRegion</code>	<p>Scrolls pixels that are inside the specified rectangle (<code>ScrollWindowRect</code>) or region (<code>ScrollWindowRegion</code>).</p> <p>The pixels are shifted a distance of <code>inHPixels</code> horizontally and <code>inVPixels</code> vertically. The positive directions are to the right and down. The pixels that are shifted out of the specified window are not displayed, and the bits they represent are not saved. The exposed empty area created by the scrolling may be added to the update region or erased to the background color/pattern of the window's graphics port.</p>

The following constants may be passed in the `inOptions` parameter of these functions:

<i>Constant</i>	<i>Meaning</i>
<code>kScrollWindowNoOptions</code>	No options.
<code>kScrollWindowInvalidate</code>	Add the exposed area to the window's update region.
<code>kScrollWindowEraseToPortBackground</code>	Erase the exposed area using the background color/pattern of the window's graphics port.

## The Window Menu

Carbon introduced the system-managed Window menu, which is created using the function `CreateStandardWindowMenu`. After creating the menu you should add it to the menu list using `InsertMenu`. Menu items containing the titles of your application's windows will be automatically added to, and deleted from, the menu when those windows are created and closed. Floating windows will not be added to the menu.

It is not necessary to set the `kWindowInWindowMenuAttribute` attribute on your document windows in order for them to be added to the menu. Document windows are automatically given this attribute.

Using `SetWindowAlternateTitle` you can override the title displayed in the Window menu. You would ordinarily do this if the window title was not expressive enough.

## Customizing the Window Menu

You can insert your own items to the Window menu by searching for the item with command ID 'wldv' and inserting your items before that item (that is, immediately before the individual window items). 'wldv' is the command ID of the divider that separates the window commands from the individual window items.

A problem here is that, at the time of writing, the divider had the 'wldv' command ID on Mac OS X but not in CarbonLib.

You can append your own items at the end of the Window menu by searching for the item with command ID 'wlst' and appending your items after that item. 'wlst' is the command ID of a hidden menu item that marks the end of the individual window items.

## Live Window Resizing

On Mac OS X, windows on which the `kWindowLiveResizeAttribute` attribute is set support live resizing. When this attribute is set, the window is continually redrawn while it is being resized, as opposed to just outlines of the window, title bar, and resize control being drawn. Full implementation of live resizing requires that the contents of the content region also be continually redrawn as the window is being resized. This requires the use of the Carbon event model.

The demonstration program `CarbonEvents2` (Chapter 17) demonstrates live resizing.

# Main Constants, Data Types, and Functions

## Constants

### Window Class

kAlertWindowClass	= 1L
kMovableAlertWindowClass	= 2L
kModalWindowClass	= 3L
kMovableModalWindowClass	= 4L
kFloatingWindowClass	= 5L
kDocumentWindowClass	= 6L
kUtilityWindowClass	= 8L
kHelpWindowClass	= 10L
kSheetWindowClass	= 11L
kToolbarWindowClass	= 12L
kPlainWindowClass	= 13L
kOverlayWindowClass	= 14L
kSheetAlertWindowClass	= 15L
kAltPlainWindowClass	= 16L
kAllWindowsClasses	= 0xFFFFFFFF

### Window Attributes

kWindowNoAttributes	= 0L
kWindowCloseBoxAttribute	= 1L << 0
kWindowHorizontalZoomAttribute	= 1L << 1
kWindowVerticalZoomAttribute	= 1L << 2
kWindowFullZoomAttribute	= kWindowVerticalZoomAttribute   kWindowHorizontalZoomAttribute
kWindowCollapseBoxAttribute	= 1L << 3
kWindowResizableAttribute	= 1L << 4
kWindowSideTitlebarAttribute	= 1L << 5
kWindowNoUpdatesAttribute	= 1L << 16
kWindowNoActivatesAttribute	= 1L << 17
kWindowNoShadowAttribute	= 1L << 21
kWindowHideOnSuspendAttribute	= 1L << 24
kWindowStandardHandlerAttribute	= 1L << 25
kWindowHideOnFullScreenAttribute	= 1L << 26
kWindowInWindowMenuAttribute	= 1L << 27
kWindowLiveResizeAttribute	= 1L << 28
kWindowStandardDocumentAttributes	= kWindowCloseBoxAttribute   kWindowFullZoomAttribute   kWindowCollapseBoxAttribute   kWindowResizableAttribute
kWindowStandardFloatingAttributes	= kWindowCloseBoxAttribute   kWindowCollapseBoxAttribute

### Window Positioning

kWindowCenterOnMainScreen	= 0x00000001
kWindowCenterOnParentWindow	= 0x00000002
kWindowCenterOnParentWindowScreen	= 0x00000003
kWindowCascadeOnMainScreen	= 0x00000004
kWindowCascadeOnParentWindow	= 0x00000005

```
kWindowCascadeOnParentWindowScreen = 0x00000006
kWindowAlertPositionOnMainScreen   = 0x00000007
kWindowAlertPositionOnParentWindow = 0x00000008
kWindowAlertPositionOnParentWindowScreen = 0x00000009
```

## Window Transition Action and Effect

```
kWindowShowTransitionAction = 1
kWindowHideTransitionAction = 2
kWindowZoomTransitionEffect = 1
```

## Window Scrolling

```
KScrollWindowNoOptions = 0
KScrollWindowInvalidate = (1L << 0)
KscrollWindowEraseToPortBackground = (1L << 1)
```

## Data Types

### Property Types

```
typedef OSType PropertyCreator;
typedef OSType PropertyTag;
```

### Window Class and Attributes

```
typedef UInt32 WindowClass;
typedef UInt32 WindowAttributes;
```

### Window Positioning

```
typedef UInt32 WindowPositionMethod;
```

### Window Transitioning

```
typedef UInt32 WindowTransitionEffect;
typedef UInt32 WindowTransitionAction;
```

### Window Scrolling

```
typedef UInt32 ScrollWindowOptions;
```

## Functions

### Floating Windows

```
Boolean AreFloatingWindowsVisible(void);
```

### Window Proxy Icons

```
OSStatus SetWindowProxyCreatorAndType(WindowRef window, OSType fileCreator, OSType fileType,
                                       SInt16 vRefNum);
OSStatus SetWindowProxyFSSpec(WindowRef window, const FSSpec *inFile);
OSStatus GetWindowProxyFSSpec(WindowRef window, FSSpec *outFile);
OSStatus GetWindowProxyAlias(WindowRef window, AliasHandle *alias);
OSStatus SetWindowProxyAlias(WindowRef window, AliasHandle alias);
OSStatus SetWindowProxyIcon(WindowRef window, IconRef icon);
OSStatus GetWindowProxyIcon(WindowRef window, IconRef *outIcon);
OSStatus RemoveWindowProxy(WindowRef window);
OSStatus TrackWindowProxyDrag(WindowRef window, Point startPt);
```

## Window Path Pop-Up Menus

```
Boolean    IsWindowPathSelectClick(WindowRef window,EventRecord *event);
OSStatus  WindowPathSelect(WindowRef window,MenuHandle menu,SInt32 *outMenuResult);
```

## Transitional Window Animations and Sounds

```
OSStatus  TransitionWindow(WindowRef window,WindowTransitionEffect effect,
                          WindowTransitionAction action,const Rect *rect);
```

## Creating and Storing Windows

```
OSStatus  CreateNewWindow(WindowClass windowClass,WindowAttributes attributes,
                          const Rect *bounds,WindowRef *outWindow);
OSStatus  CreateWindowFromResource(SInt16 resID,WindowRef *outWindow);
OSStatus  CreateWindowFromCollection(Collectioncollection,WindowRef *outWindow);
OSStatus  StoreWindowIntoCollection(WindowRef window,Collection collection);
```

## Accessing Window Information

```
OSStatus  GetWindowClass(WindowRef window,WindowClass *outClass);
OSStatus  GetWindowAttributes(WindowRef window,WindowAttributes *outAttributes);
OSStatus  ChangeWindowAttributes(WindowRef window,WindowAttributes setTheseAttributes,
                          WindowAttributes clearTheseAttributes);
Boolean    IsValidWindowRef(GrafPtr grafPort);
WindowRef  FrontNonFloatingWindow(void);
OSStatus  FindWindowOfClass(const Point *where,WindowClass inWindowClass,
                          WindowRef *outWindow,WindowPartCode *outWindowPart)
WindowRef  GetFrontWindowOfClass(WindowClass inWindowClass,Boolean mustBeVisible);
WindowRef  GetNextWindowOfClass(WindowRef inWindow,WindowClass inWindowClass,
                          Boolean mustBeVisible);
```

## Moving and Positioning Windows

```
OSStatus  MoveWindowStructure(WindowRef window,short hGlobal,short vGlobal);
OSStatus  SetWindowBounds(WindowRef window,WindowRegionCode regionCode,
                          const Rect *globalBounds);
OSStatus  GetWindowBounds(WindowRef window,WindowRegionCode regionCode,Rect *globalBounds);
OSStatus  RepositionWindow(WindowRef window,WindowRef parentWindow,
                          WindowPositionMethod method);
```

## Associating Data with Windows

```
OSStatus  SetWindowProperty(WindowRef window,PropertyCreator propertyCreator,
                          PropertyTag propertyTag,UInt32 propertySize,void *propertyBuffer);
OSStatus  GetWindowProperty(WindowRef window,PropertyCreator propertyCreator,
                          PropertyTag propertyTag,UInt32 bufferSize,UInt32 *actualSize,void *propertyBuffer);
OSStatus  GetWindowPropertySize(WindowRef window,PropertyCreator creator,PropertyTag tag,
                          UInt32 *size);
OSStatus  RemoveWindowProperty(WindowRef window,PropertyCreator propertyCreator,
                          PropertyTag propertyTag);
```

## Adding to and Removing from the Update Region

```
OSStatus  InvalWindowRect(WindowRef window,const Rect *bounds);
OSStatus  InvalWindowRgn(WindowRef window,RgnHandle region);
OSStatus  ValidWindowRect(WindowRef window,const Rect *bounds);
OSStatus  ValidWindowRgn(WindowRef window,RgnHandle region);
```

## Setting Content Region Color and Pattern

```
OSStatus SetWindowContentColor(WindowRef window, RGBColor *color);
OSStatus GetWindowContentColor(WindowRef window, RGBColor *color);
OSStatus SetWindowContentPattern(WindowRef window, PixPatHandle outPixPat);
OSStatus GetWindowContentPattern(WindowRef window, PixPatHandle pixPat);
```

## Window Scrolling

```
OSStatus ScrollWindowRect(WindowRef inWindow, const Rect *inScrollRect, Sint16 inHPixels,
    Sint16 inVPixels, ScrollWindowOptions inOptions, RgnHandle outExposedRgn);
OSStatus ScrollWindowRegion(WindowRef inWindow, RgnHandle inScrollRgn, Sint16 inHPixels,
    Sint16 inVPixels, ScrollWindowOptions inOptions, RgnHandle outExposedRgn);
```

## Creating a Window Menu

```
OSStatus CreateStandardWindowMenu(OptionBits inOptions, MenuRef *outMenu);
OSStatus SetWindowAlternateTitle(WindowRef inWindow, CFStringRef inTitle);
```

# Demonstration Program Windows2 Listing

```
// *****
// Windows2.c CLASSIC EVENT MODEL
// *****
//
// This program demonstrates the following Window Manager features and functions introduced
// with Mac OS 8.5:
//
// • Creating floating windows and document windows using CreateNewWindow.
//
// • Saving document windows and their associated data to a 'wind' resource.
//
// • Creating document windows from 'wind' resources using CreateWindowFromResource.
//
// • Managing windows in a floating windows environment.
//
// • Setting and getting a window's property.
//
// • Showing and hiding windows using TransitionWindow.
//
// • Displaying window proxy icons.
//
// The program also demonstrates the creation of the system-managed Window menu introduced
// with Carbon and, on Mac OS X, a partial implementation of live window resizing.
//
// Those aspects of the newer Window Manager features not demonstrated in this program (full
// implementation of window proxy icons and window path pop-up menus) are demonstrated at the
// demonstration program Files (Chapter 18).
//
// The program utilises the following resources:
//
// • A 'plst' resource.
//
// • An 'MBAR' resource, and 'MENU' resources for Apple, File, Edit, Document Windows and
// Floating Windows menus (preload, non-purgeable).
//
```



```

// · 'TEXT' resources for the document windows (non-purgeable).
//
// · 'PICT' resources for the floating windows (non-purgeable).
//
// · An 'ALRT' resource (purgeable), plus associated 'DITL', 'alrx', and 'dftb' resources
//   (all purgeable), for a movable modal alert invoked when the user chooses the About
//   Windows2... item from the Apple/Application menu.
//
// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// In addition, the program itself creates a 'wind' resource, and saves it to the resource
// fork of the file titled "Document", when the user chooses CreateNewWindow from the
// Document Windows menu.
//
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenubar          128
#define mFile             129
#define iQuit             12
#define rAboutAlert       128
#define rText             128
#define rColorsPicture    128
#define rToolsPicture     129
#define rWind             128
#define MIN(a,b)          ((a) < (b) ? (a) : (b))

// ..... typedefs

typedef struct
{
    TEHandle editStrucHdl;
} docStructure, **docStructureHandle;

// ..... global variables

Boolean    gRunningOnX = false;
SInt16     gDocResFileRefNum;
WindowRef  gColorsFloatingWindowRef;
WindowRef  gToolsFloatingWindowRef;
Boolean    gDone;

// ..... function prototypes

void    main                (void);
void    doPreliminaries     (void);
OSErr   quitAppEventHandler (AppleEvent *,AppleEvent *,SInt32);
void    doEvents            (EventRecord *);

```

```

void    doMouseDown          (EventRecord *);
void    doUpdate             (EventRecord *);
void    doUpdateDocumentWindow (WindowRef);
void    doActivate           (EventRecord *);
void    doActivateDocumentWindow (WindowRef, Boolean);
void    doOSEvent            (EventRecord *);
void    doAdjustMenus        (void);
void    doMenuChoice         (SInt32);
OSErr   doCreateNewWindow    (void);
OSErr   doSaveWindow         (WindowRef);
OSErr   doCreateWindowFromResource (void);
OSErr   doCreateFloatingWindows (void);
void    doCloseWindow        (WindowRef);
void    doErrorAlert         (SInt16);
void    doConcatPStrings     (Str255, Str255);

// ***** main

void main(void)
{
    MenuBarHandle    menubarHdl;
    SInt32           response;
    MenuRef          menuRef;
    OSErr            osError;
    SInt16           numberOfItems, a;
    MenuCommand      menuCommandID;
    FSSpec           fileSpecTemp;
    EventRecord       eventStructure;
    SInt32           sleepTime;
    WindowRef        windowRef;
    docStructureHandle docStrucHdl;
    UInt32           actualSize;

    // ..... do preliminaries

    doPreliminaries();

    // ..... set up menu bar and menus, customizes Window menu if running on OS X

    menubarHdl = GetNewMBar(rMenuBar);
    if(menubarHdl == NULL)
        ExitToShell();
    SetMenuBar(menubarHdl);

    CreateStandardWindowMenu(0, &menuRef);
    InsertMenu(menuRef, 0);

    DrawMenuBar();

    Gestalt(gestaltMenuMgrAttr, &response);
    if(response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
    }
}

```

```

        if(menuRef != NULL)
        {
            DeleteMenuItem(menuRef,iQuit);
            DeleteMenuItem(menuRef,iQuit - 1);
            DisableMenuItem(menuRef,0);
        }

        gRunningOnX = true;
    }

    // ..... open resource fork of file "Windows2 Document" and store file reference number

    osError = FSMakeFSSpec(0,0,"\\pWindows2 Document",&fileSpecTemp);
    if(osError == noErr)
        gDocResFileRefNum = FSpOpenResFile(&fileSpecTemp,fsWrPerm);
    else
        doErrorAlert(osError);

    // ..... create floating windows

    if(osError = doCreateFloatingWindows())
        doErrorAlert(osError);

    // ..... enter eventLoop

    gDone = false;
    sleepTime = GetCaretTime();

    while(!gDone)
    {
        if(WaitNextEvent(everyEvent,&eventStructure,sleepTime,NULL))
            doEvents(&eventStructure);
        else
        {
            if(eventStructure.what == nullEvent)
            {
                if(windowRef = FrontNonFloatingWindow())
                {
                    if(!(GetWindowProperty(windowRef,0,'docs',sizeof(docStrucHdl),&actualSize,
                                            &docStrucHdl)))
                        TEIdle((*docStrucHdl)->editStrucHdl);
                }
            }
        }
    }
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    OSErr osError;

```

```

MoreMasterPointers(128);
InitCursor();
FlushEvents(everyEvent,0);

osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
                                NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
                                0L,false);

if(osError != noErr)
    ExitToShell();
}

// ***** doQuitAppEvent

OSErr quitAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,SInt32 handlerRefcon)
{
    OSErr    osError;
    DescType returnedType;
    Size     actualSize;

    osError = AEGetAttributePtr(appEvent,keyMissedKeywordAttr,typeWildCard,&returnedType,NULL,0,
                                &actualSize);

    if(osError == errAEDescNotFound)
    {
        gDone = true;
        osError = noErr;
    }
    else if(osError == noErr)
        osError = errAEParamMissed;

    return osError;
}

// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    switch(eventStrucPtr->what)
    {
        case mouseDown:
            doMouseDown(eventStrucPtr);
            break;

        case keyDown:
            if((eventStrucPtr->modifiers & cmdKey) != 0)
            {
                doAdjustMenus();
                doMenuChoice(MenuEvent(eventStrucPtr));
            }
            break;

        case updateEvt:
            doUpdate(eventStrucPtr);
            break;
    }
}

```

```

        case activateEvt:
            doActivate(eventStrucPtr);
            break;

        case osEvt:
            doOSEvent(eventStrucPtr);
            break;
    }
}

// ***** doMouseDown

void doMouseDown(EventRecord *eventStrucPtr)
{
    WindowRef    windowRef;
    WindowPartCode partCode, zoomPart;
    SInt32        menuChoice;
    WindowClass    windowClass;
    BitMap        screenBits;
    Rect          portRect, mainScreenRect;
    Point          standardStateHeightAndWidth;

    partCode = FindWindow(eventStrucPtr->where,&windowRef);

    switch(partCode)
    {
        case kHighLevelEvent:
            AEProcessAppleEvent(eventStrucPtr);
            break;

        case inMenuBar:
            doAdjustMenus();
            doMenuChoice(MenuSelect(eventStrucPtr->where));
            break;

        case inContent:
            GetWindowClass(windowRef,&windowClass);
            if(windowClass == kFloatingWindowClass)
            {
                if(windowRef != FrontWindow())
                    SelectWindow(windowRef);
                else
                {
                    if(windowRef == gColorsFloatingWindowRef)
                        ; // Appropriate action for Colors floating window here.
                    else if(windowRef == gToolsFloatingWindowRef)
                        ; // Appropriate action for Tools floating window here.
                }
            }
            else
            {
                if(windowRef != FrontNonFloatingWindow())
                    SelectWindow(windowRef);
                else
                    ; // Appropriate action for active document window here.
            }
            break;
    }
}

```

```

case inDrag:
    DragWindow(windowRef,eventStrucPtr->where,NULL);
    break;

case inGoAway:
    GetWindowClass(windowRef,&windowClass);
    if(windowClass == kFloatingWindowClass)
    {
        if(TrackGoAway(windowRef,eventStrucPtr->where) == true)
            TransitionWindow(windowRef,kWindowZoomTransitionEffect,
                             kWindowHideTransitionAction,NULL);
    }
    else
        if(TrackGoAway(windowRef,eventStrucPtr->where) == true)
            doCloseWindow(windowRef);
    break;

case inGrow:
    ResizeWindow(windowRef,eventStrucPtr->where,NULL,NULL);
    GetWindowPortBounds(windowRef,&portRect);
    InvalWindowRect(windowRef,&portRect);
    break;

case inZoomIn:
case inZoomOut:
    mainScreenRect = GetQDGlobalsScreenBits(&screenBits)->bounds;
    standardStateHeightAndWidth.v = mainScreenRect.bottom - 100;
    standardStateHeightAndWidth.h = 600;

    if(IsWindowInStandardState(windowRef,&standardStateHeightAndWidth,NULL))
        zoomPart = inZoomIn;
    else
        zoomPart = inZoomOut;

    if(TrackBox(windowRef,eventStrucPtr->where,partCode))
        ZoomWindowIdeal(windowRef,zoomPart,&standardStateHeightAndWidth);
    break;
}
}

// ***** doUpdate

void doUpdate(EventRecord *eventStrucPtr)
{
    GrafPtr    oldPort;
    WindowRef  windowRef;

    GetPort(&oldPort);
    windowRef = (WindowRef) eventStrucPtr->message;

    BeginUpdate(windowRef);

    SetPortWindowPort(windowRef);
    doUpdateDocumentWindow(windowRef);

```

```

        EndUpdate(windowRef);

        SetPort(oldPort);
    }

// ***** doUpdateDocumentWindow

void doUpdateDocumentWindow(WindowRef windowRef)
{
    RgnHandle      visibleRegionHdl = NewRgn();
    Rect           contentRect;
    OSStatus       osError;
    UInt32         actualSize;
    docStructureHandle docStrucHdl;
    TEHandle        editStrucHdl;

    GetPortVisibleRegion(GetWindowPort(windowRef),visibleRegionHdl);
    EraseRgn(visibleRegionHdl);

    DrawGrowIcon(windowRef);

    if(!(osError = GetWindowProperty(windowRef,0,'docs',sizeof(docStrucHdl),&actualSize,
                                     &docStrucHdl)))
    {
        GetWindowPortBounds(windowRef,&contentRect);
        InsetRect(&contentRect,3,3);
        contentRect.right -= 15;
        contentRect.bottom -= 15;
        editStrucHdl = (*docStrucHdl)->editStrucHdl;
        (*editStrucHdl)->destRect = (*editStrucHdl)->viewRect = contentRect;
        TEGalText(editStrucHdl);
        TEUpdate(&contentRect,(*docStrucHdl)->editStrucHdl);
    }
}

// ***** doActivate

void doActivate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    Boolean    becomingActive;

    windowRef = (WindowRef) eventStrucPtr->message;
    becomingActive = ((eventStrucPtr->modifiers & activeFlag) == activeFlag);

    doActivateDocumentWindow(windowRef,becomingActive);
}

// ***** doActivateDocumentWindow

void doActivateDocumentWindow(WindowRef windowRef,Boolean becomingActive)
{
    docStructureHandle docStrucHdl;
    UInt32             actualSize;
    OSStatus           osError;

```



```

if(!osError = GetWindowProperty(windowRef,0,'docs',sizeof(docStrucHdl),&actualSize,
                                &docStrucHdl)))
{
    if(becomingActive)
        TEActivate((*docStrucHdl)->editStrucHdl);
    else
        TEDeactivate((*docStrucHdl)->editStrucHdl);
}
}

// ***** doOSEvent

void doOSEvent(EventRecord *eventStrucPtr)
{
    switch((eventStrucPtr->message >> 24) & 0x000000FF)
    {
        case suspendResumeMessage:
            if((eventStrucPtr->message & resumeFlag) == 1)
                SetThemeCursor(kThemeArrowCursor);
            break;
    }
}

// ***** doAdjustMenus

void doAdjustMenus(void)
{
    MenuRef      floatMenuRef;
    Boolean      isVisible;
    MenuItemIndex menuItem;

    isVisible = IsWindowVisible(gColorsFloatingWindowRef);
    GetIndMenuItemWithCommandID(NULL,'fcol',1,&floatMenuRef,&menuItem);
    CheckMenuItem(floatMenuRef,menuItem,isVisible);

    isVisible = IsWindowVisible(gToolsFloatingWindowRef);
    GetIndMenuItemWithCommandID(NULL,'ftoo',1,&floatMenuRef,&menuItem);
    CheckMenuItem(floatMenuRef,menuItem,isVisible);

    DrawMenuBar();
}

// ***** doMenuChoice

void doMenuChoice(SInt32 menuChoice)
{
    MenuID      menuID;
    MenuItemIndex menuItem;
    OSErr       osError;
    MenuCommand  commandID;

    menuID = HiWord(menuChoice);
    menuItem = LoWord(menuChoice);

```

```

    if(menuID == 0)
        return;

    osError = GetMenuItemCommandID(GetMenuRef(menuID),menuItem,&commandID);
    if(osError == noErr && commandID != 0)
    {
        switch(commandID)
        {
            case 'abou':
                Alert(rAboutAlert,NULL);
                break;

            case 'quit':
                gDone = true;
                break;

            case 'cwin':
                if(osError = doCreateNewWindow())
                    doErrorAlert(osError);
                break;

            case 'cwir':
                if(osError = doCreateWindowFromResource())
                    doErrorAlert(osError);
                break;

            case 'fcol':
                if(IsWindowVisible(gColorsFloatingWindowRef))
                    TransitionWindow(gColorsFloatingWindowRef,kWindowZoomTransitionEffect,
                                    kWindowHideTransitionAction,NULL);
                else
                    TransitionWindow(gColorsFloatingWindowRef,kWindowZoomTransitionEffect,
                                    kWindowShowTransitionAction,NULL);
                break;

            case 'ftoo':
                if(IsWindowVisible(gToolsFloatingWindowRef))
                    TransitionWindow(gToolsFloatingWindowRef,kWindowZoomTransitionEffect,
                                    kWindowHideTransitionAction,NULL);
                else
                    TransitionWindow(gToolsFloatingWindowRef,kWindowZoomTransitionEffect,
                                    kWindowShowTransitionAction,NULL);
                break;
        }
    }

    HiliteMenu(0);
}

// ***** doCreateFloatingWindows

```

```

OSErr doCreateFloatingWindows(void)
{
    Rect    contentRect;
    OSStatus osError;
    PicHandle pictureHdl;

    SetRect(&contentRect,102,59,391,132);

    if(!(osError = CreateNewWindow(kFloatingWindowClass,
                                   kWindowStandardFloatingAttributes |
                                   kWindowSideTitlebarAttribute,
                                   &contentRect,&gColorsFloatingWindowRef)))
    {
        if(pictureHdl = GetPicture(rColorsPicture))
            SetWindowPic(gColorsFloatingWindowRef,pictureHdl);

        osError = TransitionWindow(gColorsFloatingWindowRef,kWindowZoomTransitionEffect,
                                   kWindowShowTransitionAction,NULL);
    }

    if(osError != noErr)
        return osError;

    SetRect(&contentRect,149,88,213,280);

    if(!(osError = CreateNewWindow(kFloatingWindowClass,
                                   kWindowStandardFloatingAttributes,
                                   &contentRect,&gToolsFloatingWindowRef)))
    {
        if(pictureHdl = GetPicture(rToolsPicture))
            SetWindowPic(gToolsFloatingWindowRef,pictureHdl);

        osError = TransitionWindow(gToolsFloatingWindowRef,kWindowZoomTransitionEffect,
                                   kWindowShowTransitionAction,NULL);
    }

    return osError;
}

// ***** doCreateNewWindow

OSErr doCreateNewWindow(void)
{
    Rect    contentRect;
    OSStatus osError;
    WindowRef windowRef;
    docStructureHandle docStrucHdl;
    Handle    textHdl;
    MenuRef    menuRef;

    SetRect(&contentRect,10,40,470,340);

```

```

do
{
    if(osError = CreateNewWindow(kDocumentWindowClass,kWindowStandardDocumentAttributes,
                                &contentRect,&windowRef))
        break;

    if(gRunningOnX)
        ChangeWindowAttributes(windowRef,kWindowLiveResizeAttribute,0);

    if(!{(docStrucHdl = (docStructureHandle) NewHandle(sizeof(docStructure)))})
    {
        osError = MemError();
        break;
    }

    if(osError = SetWindowProperty(windowRef,0,'docs',sizeof(docStructure),
                                &docStrucHdl))
        break;

    SetPortWindowPort(windowRef);
    UseThemeFont(kThemeSmallSystemFont,smSystemScript);

    textHdl = GetResource('TEXT',rText);
    osError = ResError();
    if(osError != noErr)
        break;

    OffsetRect(&contentRect,-contentRect.left,-contentRect.top);
    InsetRect(&contentRect,3,3);
    contentRect.right -= 15;
    contentRect.bottom -= 15;

    (*docStrucHdl)->editStrucHdl = TENew(&contentRect,&contentRect);
    TEInsert(*textHdl,GetHandleSize(textHdl),(*docStrucHdl)->editStrucHdl);

    SetWTitle(windowRef,"\\pCreateNewWindow");

    if(osError = SetWindowProxyCreatorAndType(windowRef,0,'TEXT',kOnSystemDisk))
        break;
    if(osError = SetWindowModified(windowRef,false))
        break;
    if(osError = RepositionWindow(windowRef,NULL,kWindowCascadeOnMainScreen))
        break;
    if(osError = TransitionWindow(windowRef,kWindowZoomTransitionEffect,
                                kWindowShowTransitionAction,NULL))
        break;

    if(osError = doSaveWindow(windowRef))
        break;
} while(false);

```

```

if(osError)
{
    if(windowRef)
        DisposeWindow(windowRef);

    if(docStrucHdl)
        DisposeHandle((Handle) docStrucHdl);
}

return osError;
}

// ***** doSaveWindow

OSErr doSaveWindow(WindowRef windowRef)
{
    SInt16          oldResFileRefNum;
    Collection      collection = NULL;
    OSStatus        osError;
    docStructureHandle docStrucHdl;
    UInt32          actualSize;
    Handle          flatCollectHdl, flatCollectResHdl, existingResHdl;

    oldResFileRefNum = CurResFile();
    UseResFile(gDocResFileRefNum);

    do
    {
        if(!(collection = NewCollection()))
        {
            osError = MemError();
            break;
        }

        if(osError = StoreWindowIntoCollection(windowRef, collection))
            break;

        if(osError = GetWindowProperty(windowRef, 0, 'docs', sizeof(docStrucHdl), &actualSize,
                                       &docStrucHdl))
            break;

        if(osError = AddCollectionItemHdl(collection, 'TEXT', 1,
                                          (*(docStrucHdl)->editStrucHdl)->hText))
            break;

        if(!(flatCollectHdl = NewHandle(0)))
        {
            osError = MemError();
            break;
        }

        if(osError = FlattenCollectionToHdl(collection, flatCollectHdl))
            break;
    }
}

```

```

    existingResHdl = Get1Resource('wind',rWind);
    osError = ResError();
    if(osError != noErr && osError != resNotFound)
        break;

    if(existingResHdl != NULL)
        RemoveResource(existingResHdl);
    osError = ResError();
    if(osError != noErr)
        break;

    AddResource(flatCollectHdl,'wind',rWind,"\p");
    osError = ResError();
    if(osError != noErr)
        break;

    flatCollectResHdl = flatCollectHdl;
    flatCollectHdl = NULL;

    WriteResource(flatCollectResHdl);
    osError = ResError();
    if(osError != noErr)
        break;

    UpdateResFile(gDocResFileRefNum);
    osError = ResError();
    if(osError != noErr)
        break;
} while(false);

if(collection)
    DisposeCollection(collection);
if(flatCollectHdl)
    DisposeHandle(flatCollectHdl);
if(flatCollectResHdl)
    ReleaseResource(flatCollectResHdl);

UseResFile(oldResFileRefNum);

return osError;
}

// ***** doCreateWindowFromResource

OSErr doCreateWindowFromResource(void)
{
    SInt16          oldResFileRefNum;
    OSStatus        osError;
    WindowRef       windowRef;
    Collection       unflattenedCollection = NULL;
    Handle           windResHdl;
    docStructureHandle docStrucHdl;
    SInt32           dataSize = 0;
    Handle           textHdl;
    Rect             contentRect;

```

```

oldResFileRefNum = CurResFile();
UseResFile(gDocResFileRefNum);

do
{
    if(osError = CreateWindowFromResource(rWind,&windowRef))
        break;

    if(gRunningOnX)
        ChangeWindowAttributes(windowRef,kWindowLiveResizeAttribute,0);

    if(!(unflattenedCollection = NewCollection()))
    {
        osError = MemError();
        break;
    }

    windResHdl = GetResource('wind',rWind);
    osError = ResError();
    if(osError != noErr)
        break;

    if(osError = UnflattenCollectionFromHdl(unflattenedCollection,windResHdl))
        break;

    if(!(docStrucHdl = (docStructureHandle) NewHandle(sizeof(docStructure))))
    {
        osError = MemError();
        break;
    }

    if(osError = GetCollectionItem(unflattenedCollection,'TEXT',1,&dataSize,
                                kCollectionDontWantData))
        break;

    if(!(textHdl = NewHandle(dataSize)))
    {
        osError = MemError();
        break;
    }

    if(osError = GetCollectionItem(unflattenedCollection,'TEXT',1,kCollectionDontWantSize,
                                *textHdl))
        break;

    GetWindowPortBounds(windowRef,&contentRect);
    contentRect.right -= 15;
    contentRect.bottom -= 15;
    SetPortWindowPort(windowRef);
    UseThemeFont(kThemeSmallSystemFont,smSystemScript);
    (*docStrucHdl)->editStrucHdl = TNew(&contentRect,&contentRect);
    TEInsert(*textHdl,dataSize,(*docStrucHdl)->editStrucHdl);

    if(osError = SetWindowProperty(windowRef,0,'docs',sizeof(docStrucHdl),&docStrucHdl))
        break;

```



```

        SetWTitle(windowRef, "\\pCreateWindowFromResource");

        if(osError = SetWindowProxyCreatorAndType(windowRef, 0, 'TEXT', kOnSystemDisk))
            break;
        if(osError = SetWindowModified(windowRef, false))
            break;
        if(osError = RepositionWindow(windowRef, NULL, kWindowCascadeOnMainScreen))
            break;
        if(osError = TransitionWindow(windowRef, kWindowZoomTransitionEffect,
                                      kWindowShowTransitionAction, NULL))
            break;
    } while(false);

    if(unflattenedCollection)
        DisposeCollection(unflattenedCollection);
    if(windResHdl)
        ReleaseResource(windResHdl);

    UseResFile(oldResFileRefNum);

    return osError;
}

// ***** doCloseWindow

void doCloseWindow(WindowRef windowRef)
{
    OSStatus      osError;
    docStructureHandle docStrucHdl;
    UInt32        actualSize;

    do
    {
        if(osError = TransitionWindow(windowRef, kWindowZoomTransitionEffect,
                                      kWindowHideTransitionAction, NULL))
            break;

        if(osError = GetWindowProperty(windowRef, 0, 'docs', sizeof(docStrucHdl), &actualSize,
                                      &docStrucHdl))
            break;
    } while(false);

    if(osError)
        doErrorAlert(osError);

    if((*docStrucHdl)->editStrucHdl)
        TEDispose((*docStrucHdl)->editStrucHdl);

    if(docStrucHdl)
        DisposeHandle((Handle) docStrucHdl);

    DisposeWindow(windowRef);
}

```

```
// ***** doErrorAlert

void doErrorAlert(SInt16 errorCode)
{
    Str255 errorCodeString;
    Str255 theString = "\pAn error occurred. The error code is ";
    SInt16 itemHit;

    NumToString((SInt32) errorCode,errorCodeString);
    doConcatPStrings(theString,errorCodeString);

    StandardAlert(kAlertStopAlert,theString,NULL,NULL,&itemHit);
    ExitToShell();
}

// ***** doConcatPStrings

void doConcatPStrings(Str255 targetString,Str255 appendString)
{
    SInt16 appendLength;

    appendLength = MIN(appendString[0],255 - targetString[0]);

    if(appendLength > 0)
    {
        BlockMoveData(appendString+1,targetString+targetString[0]+1,(SInt32) appendLength);
        targetString[0] += appendLength;
    }
}

// *****
```

## Demonstration Program Windows2 Comments

Two Window Manager features introduced with Mac OS 8.5 (full window proxy icon implementation and window path pop-up menus) are not demonstrated in this program. However, they are demonstrated at the demonstration program associated with Chapter 18.

When the program is run, the user should

- Choose CreateNewWindow from the Document Windows menu, noting that, when the new window is displayed, the floating windows and the new (document) window are all active.  
(Note: As well as creating the window, the program loads and displays a ‘TEXT’ resource (simulating a document associated with the window) and then saves the window and the text to a ‘wind’ resource.)
- Choose CreateWindowFromResource from the Document Windows menu, noting that the window is created from the ‘wind’ resource saved when CreateNewWindow was chosen.

- Choose About Windows2... from the Apple menu, noting that the floating windows appear in the deactivated state when the alert box opens.
- Hide the floating windows by clicking their close boxes, and toggle the floating windows between hidden and showing by choosing their items in the Floating Windows menu, noting the transitional animations.
- Click in the Finder to send the application to the background, noting that the floating windows are hidden by this action. Then click in one of the application's windows, noting that the floating windows re-appear.
- Note the transitional animations when the document windows are opened and closed.
- Exercise the system-managed Window menu, noting the customization of this menu when the program is run on Mac OS X.

### **defines**

`rWind` represents the ID of the 'wind' resource created by the program.

### **typedefs**

A document structure of type `docStructure` will be associated with each document window. The single field in the document structure (`editStrucHdl`) will be assigned a handle to a `TextEdit` edit structure, which will contain the text displayed in the window.

### **Global Variables**

`gDocResFileRefNum` will be assigned the file reference number for the resource fork of the document file "Windows2 Document" included in the demo program's folder.

`gColorsFloatingWindowRef` and `gToolsFloatingWindowRef` will be assigned references to the window objects for the floating windows.

### **main**

The call to `CreateStandardWindowMenu` creates the system-managed Window menu, which is added to the menu list by the call to `InsertMenu`. If the program is running on Mac OS X, the next block customizes the Window menu by searching for the item with the command ID 'wldv' (that is, the divider between the commands and the individual window items), inserting a divider and two custom items before that item, and assigning command IDs to those items. (At the time of writing, the divider did not have the 'wldv' command ID in `CarbonLib`.)

The resource fork of the file titled "Windows2 Document" is opened and the file reference number is saved to a global variable. The program will be saving a 'wind' resource to this file's resource fork.

`CurResFile` is called to set the application's resource fork as the current resource file.

The function `doCreateFloatingWindows` is called to create and show the floating windows.

In the next block (the main event loop), `WaitNextEvent`'s sleep parameter is assigned the value returned by `GetCaretTime`. (`GetCaretTime` returns the value stored in the low memory global `CaretTime`, which determines the blinking rate for the insertion point caret as set by the user. This ensures that `TEIdle`, which causes the caret to blink, will be called at the correct interval.

When `WaitNextEvent` returns 0 with a null event, `FrontNonFloatingWindow` is called to obtain a reference to the front document window. If such a window exists, `GetWindowProperty` is called to retrieve a handle to the window's document structure. The handle to the `TextEdit` edit structure, which is stored in the window's document structure, is then passed in the call to `TEIdle`, which causes the insertion point caret to blink.

### **doMouseDown**

`doMouseDown` continues the processing of mouse-down events, switching according to the part code.

The `inContent` case is handled differently depending on whether the event is in a floating window or a document window. `GetWindowClass` returns the window's class. If the window is a floating window, and if that window is not the front floating window, `SelectWindow` is called to bring that floating window to the front. If the window is the front floating window, the identity of the window is determined and the appropriate further action is taken. (In this demonstration, no further action is taken.)

If the window is not a floating window, and if the window is not the front non-floating window, `SelectWindow` is called to

- Unhighlight the currently active non-floating window, bring the specified window to the front of the non-floating windows, and highlight it.
- Generate activate events for the two windows.
- Move the previously active non-floating window to a position immediately behind the specified window.

If the window is the front non-floating window, the appropriate further action is taken. (In this demonstration, no further action is taken.)

The `inGoAway` case is also handled differently depending on whether the event is in a floating window or a document window. `TrackGoAway` is called in both cases to track user action while the mouse-button remains down. If the pointer is still within the go away box when the mouse-button is released, and if the window is a floating window, `TransitionWindow` is called to hide the window. If the window is a non-floating window, the function `doCloseWindow` is called to close the window.

**doUpdate**

`doUpdate` further processes update events. When an update event is received, `doUpdate` calls `doUpdateDocumentWindow`. (As will be seen, in this particular demonstration, the Window Manager will not generate updates for the floating windows.)

**doUpdateDocumentWindow**

`doUpdateDocumentWindow` is concerned with the drawing of the content region of the non-floating windows.

`GetWindowProperty` is then called to retrieve the handle to the window's document structure, which, as previously stated, contains a handle to a `TextEdit` structure containing the text displayed in the window. If the call is successful, measures are taken to redraw the text in the window, taking account of the current height and width of the content region less the area that would ordinarily be occupied by scroll bars. (The `TextEdit` calls in this section are incidental to the demonstration. `TextEdit` is addressed in Chapter 21.)

**doActivateDocumentWindow**

`doActivateDocumentWindow` performs, for the non-floating windows, those window activation actions for which the application is responsible. In this demonstration, that action is limited to calling `TEActivate` or `TEDeactivate` to show or remove the insertion point caret.

`GetWindowProperty` is called to retrieve the handle to the window's document structure, which contains a handle to the `TextEdit` structure containing the text displayed in the window. If this call is successful, and if the window is being activated, `TEActivate` is called to display the insertion point caret. If the window is being deactivated, `TEDeactivate` is called to remove the insertion point caret.

**doAdjustMenus**

`doAdjustMenus` is called in the event of a mouse-down event in the menu bar when a key is pressed together with the Command key. The function checks or unchecks the items in the Floating Windows menu depending on whether the associated floating window is currently showing or hidden.

**doMenuChoice**

`doMenuChoice` switches according to the menu choices of the user.

If the user chooses the About Windows2... item from the Apple menu, `Alert` is called to display the About Windows2... alert box.

If the user chose the first item in the Document Windows menu, the function `doCreateNewWindow` is called. If the user chose the second item, the function `doCreateWindowFromResource` is called. If either of these functions return an error, an error-handling function is called.

When an item in the Floating Windows menu is chosen, `IsWindowVisible` is called to determine the visibility state of the relevant floating window. `TransitionWindow` is then called, with the appropriate constant passed in the action parameter, to hide or show the window depending on the previously determined current visibility state.

### **doCreateFloatingWindows**

`doCreateFloatingWindows` is called from main to create the floating windows.

The Colors floating window is created first. `SetRect` is called to define a rectangle, which will be used to establish the size of the window and its opening location in global coordinates. `CreateNewWindow` is then called to create a floating window (first parameter) with a close box, a collapse box, and a side title bar (second parameter), and with the previously defined content region size and location (third parameter).

If this call is successful, `GetPicture` is called to load the specified 'PICT' resource. If the resource is loaded successfully, `SetWindowPic` is called to store the handle to the picture structure in the `windowPic` field of the window's color window structure. This latter means that the Window Manager will draw the picture in the window instead of generating update events for it. Finally, `TransitionWindow` is called to make the window visible (with animation and sound).

The same general procedure is then followed to create the Tools floating window.

### **doCreateNewWindow**

`doCreateNewWindow` is called when the user chooses Create New Window from the Document Windows menu. In addition to creating a window, and for the purposes of this demonstration, `doCreateNewWindow` also saves the window and its associated data (text) in a 'wind' resource.

`SetRect` is called to define a rectangle that will be used to establish the size of the window and its opening location in global coordinates. The call to `CreateNewWindow` creates a document window (first parameter) with a close box, a full zoom box, a collapse box, and a size box (second parameter), and with the previously defined content region size and location (third parameter).

If the program is running on Mac OS X, `ChangeWindowAttributes` is called to set the `kWindowLiveResizeAttribute`. This results in a partial implementation of live resizing.

`NewHandle` is then called to create a relocatable block for the document structure to be associated with the window. `SetWindowProperty` associates the document structure with the window. 0 is passed in the `propertyCreator` parameter because this demonstration has no application signature. The value passed in the `propertyTag` parameter ('docs') is just a convenient value with which to identify the data.

The call to `SetPortWindowPort` sets the window's graphics port as the current port and the call to `UseThemeFont` sets the window's font to the small system font.

The next three blocks load a 'TEXT' resource, insert the text into a TextEdit structure, and assign a handle to that structure to the editStrucHdl field of the window's document structure. This is all for the purpose of simulating some text that the user has typed into the window.

SetWTitle sets the window's title.

The window lacks an associated file, so SetWindowProxyCreatorAndType is called to cause a proxy icon to be displayed in the window's drag bar. 0 passed in the fileCreator parameter and 'TEXT' passed in the fileType parameter cause the system's default icon for a document file to be displayed. SetWindowModified is then called with false passed in the modified parameter to cause the proxy icon to appear in the enabled state (indicating no unsaved changes).

The call to RepositionWindow positions the window relative to other windows according to the constant passed in the method parameter.

As the final step in creating the window, TransitionWindow is called to make the window visible (with animation).

To facilitate the demonstration of creating a window from a 'wind' resource (see the function doCreateWindowFromResource), a function is called to save the window and its data (the text) to a 'wind' resource in the application's resource fork.

If an error occurred within the do/while loop, if a window was created, it is disposed of. Also, if a nonrelocatable block for the document structure was created, it is disposed of.

### **doSaveWindow**

doSaveWindow is called by doCreateNewWindow to save the window and its data (the text) to a 'wind' resource.

The current resource file's file reference number is saved and the resource fork of the document titled "Windows2 Document" is made the current resource file.

The call to the Collection Manager NewCollection function allocates memory for a new collection object and initializes it. The call to StoreWindowIntoCollection stores data describing the window into the collection.

GetWindowProperty retrieves the handle to the window's document structure.

The handle to the window's text is stored in the hText field of the TextEdit structure. The handle to the TextEdit structure is, in turn, stored in the window's document structure. The Collection Manager function AddCollectionItemHdl adds a new item to the collection, specifically, a copy of the text.

The call to NewHandle allocates a zero-length handle, which will be used to hold a flattened collection. The Collection Manager function FlattenCollectionToHdl flattens the collection into a Memory Manager handle.



The next six blocks use Resource Manager functions to save the flattened collection as a 'wind' resource in the resource fork of the application file.

Get1Resource attempts to load a 'wind' resource with ID 128. If ResError reports an error, and if the error is not the "resource not found" error, the whole save process is aborted. (Accepting the "resource not found" error as an acceptable error caters for the possibility that this may be the first time the window and its data have been saved.)

If Get1Resource successfully loaded a 'wind' resource with ID 128, RemoveResource is called to remove that resource from the resource map, AddResource is called to make the flattened collection in memory into a 'wind' resource, assigning a resource type, ID and name to that resource, and inserting an entry in the resource map for the current resource file.

WriteResource is called to write the resource to the document file's resource fork. Since the resource map has been changed, UpdateResFile is called to update the resource map on disk.

Below the do/while loop, the collection and the flattened collection block are disposed of and the resource in memory is released.

Finally, the saved resource file is made the current resource file.

### **doCreateWindowFromResource**

doCreateWindowFromResource creates a window from the 'wind' resource created by doSaveWindow.

The current resource file's file reference number is saved and the resource fork of the document titled "Windows2 Document" is made the current resource file.

CreateWindowFromResource creates a window, invisibly, from the 'wind' resource with ID 128.

The call to the Collection Manager NewCollection function creates a new collection.

GetResource loads the 'wind' resource with ID 128. The Collection Manager function UnflattenCollectionFromHdl unflattens the 'wind' resource and stores the unflattened collection in the collection object unflattenedCollection.

NewHandle allocates a relocatable block the size of a window document structure.

The Collection Manager function GetCollectionItem is called twice, the first time to get the size of the text data, not the data itself. (The item in the collection is specified by the second and third parameters (tag and ID)). This allows the call to NewHandle to create a relocatable block of the same size. GetCollection is then called again, this time to obtain a copy of the text itself.

The next block creates a new TextEdit structure (TENew), assigning its handle to the editStrucHdl field of the document structure, which will be associated with the window. TEInsert inserts the copy of the text obtained by the second call to GetCollectionItem into the TextEdit structure.

The call to `SetWindowProperty` associates the document structure with the window, thus associating the `TextEdit` structure and its text with the window.

`SetTitle` sets the window's title.

The window lacks an associated file, so the Mac OS 8.5 function `SetWindowProxyCreatorAndType` is called to cause a proxy icon to be displayed in the window's drag bar. 0 passed in the `fileCreator` parameter and 'TEXT' passed in the `fileType` parameter cause the system's default icon for a document file to be displayed. `SetWindowModified` is then called with false passed in the modified parameter to cause the proxy icon to appear in the enabled state (indicating no unsaved changes).

The call to `RepositionWindow` positions the window relative to other windows according to the constant passed in the method parameter.

As the final step in creating the window, `TransitionWindow` is called to make the window visible (with animation).

Below the do/while loop, the unflattened collection is disposed of and the 'wind' resource is released.

Finally, the saved resource file is made the current resource file.

### **doCloseWindow**

`doCloseWindow` is called when the user clicks the close box of a document window.

`TransitionWindow` is called to hide the window (with animation). `GetWindowProperty` is then called to retrieve a handle to the window's document structure, allowing the memory occupied by the `TextEdit` structure and document structure associated with the window to be disposed of. `DisposeWindow` is then called to remove the window from the window list and discard all its data storage.

### **doErrorAlert**

`doErrorAlert` is called when errors are detected. In this demonstration, the action taken is somewhat rudimentary. A stop alert box displaying the error number is invoked. When the user dismisses the alert box, the program terminates. `eventFilter` supports `doErrorAlert`.

# The Carbon Event Manager

## CHAPTER

# 17

## IN THIS CHAPTER

- Overview 892
- Event Reference, Class, and Type 893
- Standard Event Handlers 894
- The Application's Event Handlers 895
- Sending and Explicitly Propagating Events 899
- Event Timers 900
- Getting Event Time 900
- Other Aspects of the Carbon Event Model 901
- Main Constants, Data Types, and Functions 902
- Relevant Window Manager Constants and Functions 906
- Demonstration Program CarbonEvents1 Listing 906
- Demonstration Program CarbonEvents1 Comments 909
- Demonstration Program CarbonEvents2 Listing 911
- Demonstration Program CarbonEvents2 Comments 938

## Overview

### The Carbon Event Model

The Carbon event model, which was introduced with Carbon as an alternative to what is now termed the Classic event model, reduces the amount of events-related code required by an application and, in addition, facilitates a more efficient allocation of processing time on the preemptive multitasking Mac OS X. Indeed, the Carbon event model is the underlying event model on Mac OS X, the Classic event model being constructed on top of this model and emulated by the Carbon Event Manager.

### Event Handling Basics

As will by now be apparent, applications using the Classic event model spend a large amount of time in the `WaitNextEvent` loop handling such user-interface events as mouse-downs and key-downs. In the Carbon event model, this continual and inefficient “polling” for events is avoided, events being dispatched directly to Toolbox objects.

### Standard Event Handlers

These dispatched events may be handled automatically by **standard (default) event handlers** provided by the Carbon Event Manager if you so specify. The provision of standard event handlers greatly simplifies the programming task. As an example, and as will be seen in the demonstration program `CarbonEvents1`, your application requires no code at all to handle basic window dragging, resizing, zooming, activation, and deactivation operations.

Standard event handlers are provided for each type of **event target** (windows, menus, controls, and the application itself).

### Overriding and Complementing the Standard Handlers

At the same time, you can override or complement the standard behavior provided by the standard event handlers by writing your own handlers and installing them on the relevant objects. Your application’s event handler will override the standard event handler if it returns `noErr`, which defeats the event being passed to the standard handler. Your application’s event handler will complement the standard event handler if it returns `eventNotHandledErr`, which causes the event to be further propagated to the standard event handler following handling by your application’s event handler. (Event handlers are installed on a stack, the most recently installed on top. The most recently installed handler is called first.)

### The Basic Approach

The basic approach to using the Carbon event model API is thus to install the relevant standard event handlers first and then register the types of events your application wishes to receive in order to override or complement the actions of the standard handlers.

## Event Propagation Order

Events are propagated in a particular order, that order depending on the type of event. For example, control-related events are sent first to the control, then to the owning window, and then to the application. This means that you can install a handler for the control on either the control, the owning window (as in the demonstration program `CarbonEvents1`), or the application.

As another example, menu-related events are sent first to the menu, then to the user focus target (that is, the object with current keyboard focus, which can be either a window or a control), then to the application.

## RunApplicationEventLoop

At the point where a Classic event model version of your application would call `WaitNextEvent` to enter the main event loop, your Carbon event model application calls the Carbon Event Manager function `RunApplicationEventLoop`. `RunApplicationEventLoop`

- Moves events from lower-level OS queues into the Carbon queue.
- Dispatches those events from the Carbon queue to the standard event handlers and, for events types that your application has registered, to your application's event handlers.

When an event occurs that requires your program's attention, the Carbon Event Manager calls the handler for that event type. On return from the handler, your program is suspended until the next event requiring its attention is received. Thus your program only uses processor time when processing an event, other programs and processes running in the meantime.

## Event Timers

The Carbon Event Manager supports the installation of **timers**, which can be set to fire either once or repeatedly, and which may be used to trigger calls to a specified function at a specified elapsed time or at specified intervals.

## Event Reference, Class, and Type

### Event Reference

The **event reference** is the core Carbon Event Manager data structure:

```
typedef struct OpaqueEventRef *EventRef;
```

### Event Class and Type

As was stated in Chapter 2, the Classic event model is limited to a maximum of 16 event types. By contrast, the Carbon event model can accommodate an unlimited number of **event types**. Event types are grouped by **event class**.

Typical event classes, as represented by constants in `CarbonEvents.h`, are as follows:

```
kEventClassApplication  
kEventClassWindow  
kEventClassControl  
kEventClassMenu
```

Each event class comprises a number of event types. For example, some of the many event types pertaining to the `kEventClassWindow` event class, as represented by constants in `CarbonEvents.h`, are as follows:

```
kEventWindowDrawContent  
kEventWindowActivated  
kEventWindowClickDragRgn  
kEventWindowGetIdealSize
```

Given an event reference, your application can ascertain the class and type of a received event by calling `GetEventClass` and `GetEventKind`.

## Standard Event Handlers

### Standard Application Event Handler

The standard application event handler is installed automatically when your application calls `RunApplicationEventLoop`. Amongst other things, the standard application event handler handles application-activated and application-deactivated events (in Classic event model parlance, resume and suspend events).

### Standard Window Event Handler

The standard window event handler handles all of the possible user interactions with a window (dragging, resizing, zooming, activation, deactivation, and so on.). It must be explicitly installed on the target window by your application. You can cause the standard window event handler to be installed on a window as follows:

- For a window created from a 'WIND' resource using `GetNewCWindow`, either set the standard handler attribute in a call to the function `ChangeWindowAttributes`, for example:  

```
ChangeWindowAttributes(windowRef, kWindowStandardHandlerAttribute, 0);
```

or call `InstallStandardEventHandler`, passing in an event target reference (type `EventTargetRef`) obtained using `GetWindowEventTarget`, for example:  

```
InstallStandardEventHandler(GetWindowEventTarget(windowRef));
```
- For a window created using `CreateNewWindow`, pass `kWindowStandardHandlerAttribute` in the attributes parameter.



# The Application's Event Handlers

## Handlers are Callback Functions

The handlers provided by your application are callback functions. When called, they are passed

- A reference to the event handler call (type `EventHandlerCallRef`).
- The event reference, from which you can extract the event class and type.
- A pointer to user data ( assuming that you passed a pointer to that data when you installed the handler).

## Installing the Application's Event Handlers

You can install handlers provided by your application using `InstallEventHandler`:

```
OSStatus InstallEventHandler(EventTargetRef inTarget, EventHandlerUPP inHandler,
                           UInt32 inNumTypes, const EventTypeSpec *inList,
                           void *inUserData, EventHandlerRef *outRef);
```

**inTarget** An event target reference to the event target the handler is to be registered with. Use one of the following functions to obtain this reference:

```
GetApplicationEventTarget
GetWindowEventTarget
GetControlEventTarget
GetMenuEventTarget
GetUserFocusEventTarget
```

**inHandler** A universal procedure pointer to the handler function provided by your application.

**inNumTypes** The number of event types to be registered by this call to `InstallEventHandler`.

**inList** A pointer to an array of type `EventTypeSpec` structures specifying the event types being registered. The `EventTypeSpec` structure is as follows:

```
struct EventTypeSpec
{
    UInt32 eventClass; // Event class
    UInt32 eventKind; // Event type
};
typedef struct EventTypeSpec EventTypeSpec;
```

For example, if you wished to register the `kEventWindowDrawContent` and `kEventWindowActivated` event types, you would define the array as follows:

```
EventTypeSpec myTypes[] = { { kEventClassWindow, kEventWindowDrawContent },
                             { kEventClassWindow, kEventWindowActivated } };
```



**inUserData** Optionally, a pointer to data to be passed to your event handler when it is called.

**outRef** If you will later need to remove the handler, pass a pointer to a variable of type `EventHandlerRef` in this parameter. On return, this variable will receive the event handler reference that will be required by your call to `RemoveEventHandler`.

You can also use the following macros, which are derived from the function `InstallEventHandler`, to install your application's handlers:

```
InstallApplicationEventHandler
InstallWindowEventHandler
InstallControlEventsHandler
InstallMenuEventHandler
```

Different objects of the same type do not have to have the same handler. For example, you can install separate handlers on each of two windows.

## Inside The Application's Event Handlers

### Getting Event Parameters

In some circumstances, in order to correctly handle a particular event type, you may need to extract specific data from the event using the function `GetEventParameter`. For example, on receipt of an event in the `kEventClassWindow` class, you will almost invariably need to call `GetEventParameter` to get the window reference required to facilitate the handling of certain event types in that class. Similarly, on receipt of an event of type `kEventMouseDown`, you might need to call `GetEventParameter` to obtain the mouse location.

The `GetEventParameter` prototype is as follows:

```
OSStatus GetEventParameter(EventRef inEvent, EventParamName inName,
                           EventParamType inDesiredType, EventParamType *outActualType,
                           UInt32 inBufferSize, UInt32 *outActualSize, void *outData);
```

**inEvent** A reference to the event.

**inName** The parameter's symbolic name. Symbolic names pertaining to the various event types are listed in `CarbonEvents.h` immediately after the enumerations for those types. For example, the symbolic name for the mouse location is `kEventParamMouseLocation`.

**inDesiredType** The type of data. This is listed against the parameter's symbolic name in `CarbonEvents.h`. For example, the type of data pertaining to the symbolic name `kEventParamMouseLocation` is `typeQDPoint`.

**outActualType** Actual type of value returned. Specify `NULL` if this information is not needed.

**inBufferSize** The size of the output buffer.

**outActualSize** Actual size of value returned. Specify `NULL` if this information is not needed.

`outData` A pointer to the buffer that will receive the parameter data.

The types of data that can be extracted from an event depends on the type of event. The parameter symbolic names and data types listed in `CarbonEvents.h` together indicate the type, or types, of data obtainable from an event of a particular type.

## Event Parameters and Command Events

The Carbon Event Manager can associate special **command events** with menu items with command IDs. You can, of course, assign your own command IDs to menu items using `SetMenuItemCommandID`; however, note that `CarbonEvents.h` defines command IDs for many common menu items, for example:

```
kHICommandQuit  = FOUR_CHAR_CODE('quit')
kHICommandUndo  = FOUR_CHAR_CODE('undo')
kHICommandCut   = FOUR_CHAR_CODE('cut ')
kHICommandPaste = FOUR_CHAR_CODE('past')
```

When a menu item with a command ID is chosen by the user, either with the mouse or using a Command-key equivalent, the Carbon Event Manager dispatches the relevant command event (class `kEventClassCommand`, type `kEventProcessCommand`).

When your application's handler receives a `kEventProcessCommand` event type, you pass `kEventParamDirectObject` in the `inName` parameter of your `GetEventParameter` call, `typeHICCommand` in the `inDesiredType` parameter, and the address of a structure of type `HICCommand` in the `outData` parameter. The `HICCommand` structure is as follows:

```
struct HICCommand
{
    UInt32 attributes;
    UInt32 commandID;
    struct
    {
        MenuRef menuRef;
        UInt16 menuItemIndex;
    } menu;
};
typedef struct HICCommand HICCommand;
```

Thus you will be able to extract the menu reference and menu item number, as well as the command ID of the chosen menu item (if any), from the data returned by the call to `GetEventParameter`.

## Quit Command Handling

The Quit command event is a special case. When the Quit item is chosen, the standard application event handler calls either the default Quit Application Apple event handler or your application's Quit Application Apple event handler if it has installed its own. (When your application calls `RunApplicationEventLoop`, the default Quit Application Apple event handler is automatically installed if the application has not installed its own.)

Thus the only action required by your application's handler is to ensure that it returns `eventNotHandledErr` when it determines that the `commandID` field of the `HICCommand` structure contains `kHICCommandQuit`, thereby causing the event to be propagated to the standard application event handler and thence to the relevant Quit Application Apple event handler.

For this to work on Mac OS 8/9, your application must assign the command ID `kHICCommandQuit` to the Quit item at program start when the application determines that it is running on Mac OS 8/9.

## Setting Event Parameters

In certain circumstances, your handler will need to call `SetEventParameter` to set a piece of data for a given event. For example, suppose you wish to constrain window resizing to a specified minimum size and, accordingly, register for the `kEventWindowGetMinimumSize` event type. When this event type is received by your handler (it will be dispatched when a mouse-down occurs in the size box/resize control of a window on which your handler is installed), your handler should call `SetEventParameter` with `kEventParamDimensions` passed in the `inName` parameter and a pointer to a variable of type `Point` passed in the `inDataPtr` parameter. (The `Point` variable should contain the desired minimum window height and width.)

## Converting an Event Reference to an Event Record

In certain circumstances, your handler may need to convert the event reference to a Classic event model event structure (type `EventRecord`) in order to be able to handle the event. You can use the function `ConvertEventRefToEventRecord` for that purpose.

## Menu Adjustment

You can ensure that your application's menu adjustment function is called when appropriate by registering the `kEventMenuEnableItems` event type (`kEventClassMenu` event class) and calling your menu adjustment function when that event type is received. The `kEventMenuEnableItems` event type will be dispatched when a mouse-down occurs in the menu bar and when a menu-related Command-key equivalent is pressed.

## Cursor Shape Changing

In Classic event model applications, the application's cursor shape-changing function is typically called when mouse-moved Operating System events are received. An alternative "trigger" is required when using the Carbon event model.

One approach is to install a Carbon events timer set to fire at an appropriate interval and call the cursor shape-changing function when the timer fires. However, this method is not recommended for Mac OS X because it is somewhat like polling for an event, which is more processor-intensive.

The recommended approach is to register for the `kEventMouseMoved` event type (`kEventClassMouse` event class) and call the cursor shape-changing function on receipt of that event type.

## Window Updating

To accommodate window content region updating (re-drawing) requirements, your application should register for the `kEventWindowDrawContent` event type (`kEventClassWindow` event class) and call its update function when that event type is received.

Note that the Window Manager sends an event of type `kEventWindowUpdate` to all windows that need updating, regardless of whether those windows have the standard window event handler installed. If the standard window event handler is installed, then when the standard handler receives the `kEventWindowUpdate` event, it calls `BeginUpdate`, sends a `kEventWindowDrawContent` event, and calls `EndUpdate`. There is thus no need for your update function to call `BeginUpdate` and `EndUpdate` when responding to `kEventWindowDrawContent` events.

## Handler Disposal

All handlers on a target are automatically disposed of when the target is disposed of.

## Sending and Explicitly Propagating Events

### Sending Events

You can send an event to a specified event target using either the function `SendEventToEventTarget` or the following macros derived from that function:

```
SendEventToApplication  
SendEventToWindow  
SendEventToControl  
SendEventToMenu  
SendEventToUserFocus
```

### Explicitly Propagating Events

You can explicitly propagate an event up the propagation chain by calling `CallNextEventHandler` within your event handler. This is useful in circumstances where, for example, you wish to incorporate the standard handler's response into your own pre- or post-processing.

## Event Timers

Event timers may be used for many purposes. The most common one is to trigger a call to your application's idle function, perhaps for the purpose of blinking the insertion point caret. You can use `InstallEventLoopTimer` to install an event timer:

```
OSStatus InstallEventLoopTimer(EventLoopRef inEventLoop, EventTimeInterval inFireDelay,
                               EventTimeInterval inInterval,
                               EventLoopTimerUPP inTimerProc, void *inTimerData,
                               EventLoopTimerRef *outTimer);
```

**inEventLoop** The event loop on which the timer is to be installed. Usually, this will be the event loop reference returned by a call to `GetCurrentEventLoop`.

**inFireDelay** The required delay before the timer first fires. This can be 0.

**inInterval** A value of type `double` specifying the interval at which the timer is required to fire. For one-shot timers, 0 should be passed in this parameter. For a timer whose purpose is to trigger calls to an idle function which blinks the insertion point caret, pass the value returned by a call to `GetCaretTime` converted to **event time** by the macro `TicksToEventTime`.

Note that event time is in seconds since system startup. You can use the macros `TicksToEventTime` and `EventTimeToTicks` to convert between ticks and event time.

**inTimerProc** A universal procedure pointer to the function to be called when the timer fires.

**inTimerData** Optionally, a pointer to data to be passed to the function called when the timer fires.

**outTimer** A reference to the newly installed timer. Usually, this will be required only if you intend to remove the timer at some point.

Note that, depending on the parameters passed to this function, the timer can be set to fire either once or repeatedly at a specified interval.

You can remove an installed timer by calling `RemoveEventLoopTimer`.

## Getting Event Time

Your application can determine the time an event occurred using the function `GetEventTime`. It can also determine the time from system startup using the function `GetCurrentEventTime`.

## Other Aspects of the Carbon Event Model

### The Carbon Event Model and Apple Events

Your application requires no code at all to ensure that, when Apple events are dispatched to it, its Apple event handlers are called.

### Carbon Event Model and Control Hierarchies

When you establish an embedding hierarchy for controls, you are also establishing an event handling chain. When you click in a given control, the event is sent first to that control. If that control does not handle the event (that is, its handler returns `eventNotHandledErr`), the event is passed up the chain to the control that contains the first control, and so on up the chain.

### Carbon Event Model and Event Filter Functions

In Classic event model applications, you must pass a universal procedure pointer to an application-defined event filter (callback) function in the `modalFilter` parameter of `ModalDialog`, and call your application's window updating function within the filter function.

Calling your window updating function from within your event filter function is not necessary in Carbon event model applications provided the application installs the standard window event handler on the relevant windows, registers for the `kEventWindowDrawContent` event type, and calls its window updating function when that event type is received.

### Mouse Tracking

The demonstration program `QuickDraw` (Chapter 12) uses the Event Manager function `StillDown` in the `doDrawWithMouse` function to determine whether the mouse button has been continuously pressed since the most recent `MouseDown` event. The Event Manager function `WaitMouseUp` is often used for similar purposes.

For reasons of efficient use of processor cycles, `TrackMouseLocation` should be used in lieu of `StillDown` and `WaitMouseUp` in applications intended to run on Mac OS X.

(`TrackMouseLocation` does not return control to your application until the mouse is moved or the mouse button is released.) When `TrackMouseLocation` returns, the `outResult` parameter contains a value representing the type of mouse activity that occurred (press, release, and so on) and the `outPt` parameter contains the mouse location.

The function `TrackMouseRegion` is similar to `TrackMouseLocation` except that `TrackMouseRegion` only returns when the mouse enters or exits a specified region.

## Alternative for Delay Function on Mac OS X

Programs sometimes call the function `Delay` to pause program execution for the number of ticks passed in the duration parameter. On Mac OS X, if the delay is more than about two seconds, the cursor will automatically be set to the wait cursor. To avoid this, you can instead call the function `RunCurrentEventLoop` with the required delay in seconds (perhaps converted from ticks using the macro `TicksToEventTime`) passed in the `inTimeout` parameter.

## Main Constants, Data Types, and Functions

### Constants

#### Error Codes

<code>eventAlreadyPostedErr</code>	= -9860
<code>eventClassInvalidErr</code>	= -9862
<code>eventClassIncorrectErr</code>	= -9864
<code>eventHandlerAlreadyInstalledErr</code>	= -9866
<code>eventInternalErr</code>	= -9868
<code>eventKindIncorrectErr</code>	= -9869
<code>eventParameterNotFoundErr</code>	= -9870
<code>eventNotHandledErr</code>	= -9874
<code>eventLoopTimedOutErr</code>	= -9875
<code>eventLoopQuitErr</code>	= -9876
<code>eventNotInQueueErr</code>	= -9877

#### Event Classes

<code>kEventClassMouse</code>	= <code>FOUR_CHAR_CODE('mous')</code>
<code>kEventClassKeyboard</code>	= <code>FOUR_CHAR_CODE('keyb')</code>
<code>kEventClassTextInput</code>	= <code>FOUR_CHAR_CODE('text')</code>
<code>kEventClassApplication</code>	= <code>FOUR_CHAR_CODE('appl')</code>
<code>kEventClassMenu</code>	= <code>FOUR_CHAR_CODE('menu')</code>
<code>kEventClassWindow</code>	= <code>FOUR_CHAR_CODE('wind')</code>
<code>kEventClassControl</code>	= <code>FOUR_CHAR_CODE('cntl')</code>
<code>kEventClassCommand</code>	= <code>FOUR_CHAR_CODE('cmds')</code>

#### Event Types

<code>kEventMouseDown</code>	= 1
<code>kEventMouseUp</code>	= 2
<code>kEventMouseMove</code>	= 5
<code>kEventMouseDragged</code>	= 6
<code>kEventRawKeyDown</code>	= 1
<code>kEventRawKeyRepeat</code>	= 2
<code>kEventRawKeyUp</code>	= 3
<code>kEventRawKeyModifiersChanged</code>	= 4
<code>kEventAppActivated</code>	= 1
<code>kEventAppDeactivated</code>	= 2
<code>kEventAppQuit</code>	= 3
<code>kEventAppLaunchNotification</code>	= 4



kEventMenuEnableItems	= 8
kEventWindowUpdate	= 1
kEventWindowDrawContent	= 2
kEventWindowActivated	= 5
kEventWindowDeactivated	= 6
kEventWindowGetClickActivation	= 7
kEventWindowShown	= 24
kEventWindowHidden	= 25
kEventWindowBoundsChanging	= 26
kEventWindowBoundsChanged	= 27
kEventWindowClickDragRgn	= 32
kEventWindowClickResizeRgn	= 33
kEventWindowClickCollapseRgn	= 34
kEventWindowClickCloseRgn	= 35
kEventWindowClickZoomRgn	= 36
kEventWindowClickContentRgn	= 37
kEventWindowClickProxyIconRgn	= 38
kEventControlHit	
kEventProcessCommand	= 1

## HI Commands

kHICommandOK	= FOUR_CHAR_CODE('ok ')
kHICommandQuit	= FOUR_CHAR_CODE('quit')
kHICommandCancel	= FOUR_CHAR_CODE('not!')
kHICommandUndo	= FOUR_CHAR_CODE('undo')
kHICommandRedo	= FOUR_CHAR_CODE('redo')
kHICommandCut	= FOUR_CHAR_CODE('cut ')
kHICommandCopy	= FOUR_CHAR_CODE('copy')
kHICommandPaste	= FOUR_CHAR_CODE('past')
kHICommandClear	= FOUR_CHAR_CODE('clea')
kHICommandSelectAll	= FOUR_CHAR_CODE('sall')
kHICommandHide	= FOUR_CHAR_CODE('hide')
kHICommandPreferences	= FOUR_CHAR_CODE('pref')
kHICommandZoomWindow	= FOUR_CHAR_CODE('zoom')
kHICommandMinimizeWindow	= FOUR_CHAR_CODE('mini')
kHICommandArrangeInFront	= FOUR_CHAR_CODE('frnt')

## Mouse Tracking Result

kMouseTrackingMousePressed	= 1
kMouseTrackingMouseReleased	= 2
kMouseTrackingMouseExited	= 3
kMouseTrackingMouseEntered	= 4
kMouseTrackingMouseMoved	= 5

## Data Types

```
typedef struct OpaqueEventRef *EventRef;
typedef struct OpaqueEventHandlerRef *EventHandlerRef;
typedef struct OpaqueEventHandlerCallRef *EventHandlerCallRef;
typedef struct OpaqueEventLoopRef *EventLoopRef;
typedef double EventType;
typedef UInt16 MouseTrackingResult;
```

## EventTypeSpec

```
struct EventTypeSpec
{
    UInt32 eventClass;
    UInt32 eventKind;
};
typedef struct EventTypeSpec EventTypeSpec;
```

## HICommand

```
struct HICommand
{
    UInt32 attributes;
    UInt32 commandID;
    struct
    {
        MenuRef menuRef;
        UInt16 menuItemIndex;
    } menu;
};
typedef struct HICommand HICommand;
```

# Functions and Macros

## Installing and Removing Event Handlers

```
OSStatus InstallStandardEventHandler(EventTargetRef inTarget);
OSStatus InstallEventHandler(EventTargetRef inTarget, EventHandlerUPP inHandler,
                           UInt32 inNumTypes, const EventTypeSpec *inList,
                           void *inUserData, EventHandlerRef *outRef);

#define InstallApplicationEventHandler(h,n,l,u,r) \
    InstallEventHandler(GetApplicationEventTarget(),(h),(n),(l),(u),(r))
#define InstallWindowEventHandler(t,h,n,l,u,r) \
    InstallEventHandler(GetWindowEventTarget(t),(h),(n),(l),(u),(r))
#define InstallControlEventHandler(t,h,n,l,u,r) \
    InstallEventHandler(GetControlEventTarget(t),(h),(n),(l),(u),(r))
#define InstallMenuEventHandler(t,h,n,l,u,r) \
    InstallEventHandler(GetMenuEventTarget(t),(h),(n),(l),(u),(r))

OSStatus RemoveEventHandler(EventHandlerRef inHandlerRef);
OSStatus AddEventTypesToHandler(EventHandlerRef inHandlerRef, UInt32 inNumTypes,
                               const EventTypeSpec *inList);
OSStatus RemoveEventTypesFromHandler(EventHandlerRef inHandlerRef, inNumTypes,
                                     const EventTypeSpec *inList);
```

## Creating and Disposing of Event Handler UPPs

```
EventHandlerUPP NewEventHandlerUPP(EventHandlerProcPtr userRoutine);
void DisposeEventHandlerUPP(EventHandlerUPP userUPP);
```

## Running and Quitting Application Event Loop

```
void RunApplicationEventLoop(void);
void QuitApplicationEventLoop(void);
```

## Getting Event Class and Kind

```
UInt32    GetEventClass(EventRef inEvent);
UInt32    GetEventKind(EventRef inEvent);
```

## Testing for User Cancelled

```
Boolean    IsUserCancelEventRef(EventRef event);
```

## Getting Data From Events

```
OSStatus   GetEventParameter(EventRef inEvent, EventParamName inName,
                             EventParamType inDesiredType, EventParamType *outActualType,
                             UInt32 inBufferSize, UInt32 *outActualSize, void *ioBuffer);
```

## Converting an Event Reference to an EventRecord

```
Boolean    ConvertEventRefToEventRecord(EventRef inEvent, EventRecord *outEvent);
```

## Sending Events

```
OSStatus   SendEventToEventTarget(EventRef inEvent, EventTargetRef inTarget);
#define     SendEventToApplication(e) \
            SendEventToEventTarget((e), GetApplicationEventTarget())
#define     SendEventToWindow(e, t) \
            SendEventToEventTarget((e), GetWindowEventTarget(t))
#define     SendEventToControl(e, t) \
            SendEventToEventTarget((e), GetControlEventTarget(t))
#define     SendEventToMenu(e, t) \
            SendEventToEventTarget((e), GetMenuEventTarget(t))
#define     SendEventToUserFocus(e) \
            SendEventToEventTarget((e), GetUserFocusEventTarget())
```

## Installing, Resetting, and Removing Timers

```
OSStatus   InstallEventLoopTimer(EventLoopRef inEventLoop, EventTimerInterval inFireDelay,
                                 EventTimerInterval inInterval,
                                 EventLoopTimerUPP inTimerProc, void *inTimerData,
                                 EventLoopTimerRef *outTimer);
OSStatus   SetEventLoopTimerNextFireTime(EventLoopTimerRef inTimer,
                                           EventTimerInterval inNextFire);
OSStatus   RemoveEventLoopTimer(EventLoopTimerRef inTimer);
```

## Calling Through to Handlers Below Current Handler

```
OSStatus   CallNextEventHandler(EventHandlerCallRef inCallRef, EventRef inEvent);
```

## Getting Event and System Time

```
EventTime  GetEventTime(EventRef inEvent);
EventTime  GetCurrentEventTime(void);
```

## Converting Between Ticks and EventTime

```
#define TicksToEventTime(t)    (EventTime) ((t) / 60.0)
#define EventTimeToTicks(t)    (UInt32)      ((t) * 60)
```

## Mouse Tracking

```
OSStatus   TrackMouseLocation(GrafPtr inPort, Point *outPt, MouseTrackingResult *outResult);
OSStatus   TrackMouseRegion(GrafPtr inPort, RgnHandle inRegion, Boolean *ioWasInRgn,
                             MouseTrackingResult *outResult);
```

## Relevant Window Manager Constants and Functions

### Constants

kWindowStandardHandlerAttribute = (1L << 25)

### Functions

OSStatus ChangeWindowAttributes(WindowRef window, WindowAttributes setTheseAttributes, WindowAttributes clearTheseAttributes);

## Demonstration Program CarbonEvents1 Listing

```
// *****
// CarbonEvents1.c                                     CARBON EVENT MODEL
// *****
//
// This program opens a kWindowFullZoomGrowDocumentProc window, creates a root control for
// the window (on Mac OS 8/9), and adds a pop-up menu button control to the window.
//
// The standard application event handler handles all application events. The standard
// window event handler is installed on the window. In addition, the program installs its own
// handler on the window for the purpose of determining which item the user chooses in the
// pop-up menu button's menu. (Although installed on the window, this handler could just as
// easily be installed on the control.)
//
// The program utilizes the following resources:
//
// · A 'plst' resource.
//
// · An 'MBAR' resource, and 'MENU' resources for OS9Apple/Application, File, and Edit menus
//   and the pop-up menu (preload, non-purgeable).
//
// · A 'WIND' resource (purgeable) (initially not visible).
//
// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****
// ..... includes
#include <Carbon.h>
// ..... defines
#define rMenubar 128
#define rWindow 128
#define mFile 129
#define iQuit 12
#define mPopupMenu 131
```

```
// ..... global variables

Boolean gRunningOnX = false;

// ..... function prototypes

void      main                (void);
void      doPreliminaries     (void);
OSStatus  windowEventHandler  (EventHandlerCallRef,EventRef,void *);
void      doNewWindow         (void);
void      doGetControls       (WindowRef);

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;
    MenuRef        menuRef;

    // ..... do preliminaries

    doPreliminaries();

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMenuBar);
    if(menubarHdl == NULL)
        ExitToShell();
    SetMenuBar(menubarHdl);
    DrawMenuBar();

    Gestalt(gestaltMenuMgrAttr,&response);
    if(response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
        {
            DeleteMenuItem(menuRef,iQuit);
            DeleteMenuItem(menuRef,iQuit - 1);
        }

        gRunningOnX = true;
    }
    else
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
            SetMenuItemCommandID(menuRef,iQuit,kHICCommandQuit);
    }

    // ..... open window

    doNewWindow();
}
```

```

// ..... run application event loop

RunApplicationEventLoop();
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(32);
    InitCursor();
}

// ***** doNewWindow

void doNewWindow(void)
{
    WindowRef    windowRef;
    OSStatus     osError;
    Rect         controlRect = { 42,39,62,235 };
    ControlRef    controlRef;
    EventTypeSpec windowEvents[] = { { kEventClassControl, kEventControlHit } };

    // ..... open window and set attributes

    if(!(windowRef = GetNewCWindow(rWindow,NULL,(WindowRef) -1)))
        ExitToShell();
    SetPortWindowPort(windowRef);

    ChangeWindowAttributes(windowRef,kWindowStandardHandlerAttribute ,0);

    // ..... install window event handler

    InstallWindowEventHandler(windowRef,
                             NewEventHandlerUPP((EventHandlerProcPtr) windowEventHandler),
                             GetEventTypeCount(windowEvents),windowEvents,0,NULL);

    // ..... create root control for window and get popup button control

    if(!gRunningOnX)
        CreateRootControl(windowRef,&controlRef);

    if((osError = CreatePopupButtonControl(windowRef,&controlRect,CFSTR("Time Zone:"),
                                           mPopupMenu,false,-1,0,0,&controlRef)) != noErr)
        ExitToShell();

    // ..... show window

    ShowWindow(windowRef);
}

```

```
// ***** windowEventHandler

OSStatus windowEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                           void* userData)
{
    OSStatus    result = eventNotHandledErr;
    UInt32      eventKind;
    ControlRef   controlRef;
    MenuRef      menuRef;
    Size         actualSize;
    SInt16       controlValue;
    Str255       menuItemString;
    Rect         theRect = { 0, 0, 40, 293 };
    CFStringRef  stringRef;
    Rect         textBoxRect;

    eventKind = GetEventKind(eventRef);

    if(eventKind == kEventControlHit)
    {
        GetEventParameter(eventRef, kEventParamDirectObject, typeControlRef, NULL,
                          sizeof(controlRef), NULL, &controlRef);

        GetControlData(controlRef, kControlEntireControl, kControlPopupMenuHandleTag,
                       sizeof(menuRef), &menuRef, &actualSize);
        controlValue = GetControlValue(controlRef);
        GetMenuItemText(menuRef, controlValue, menuItemString);

        EraseRect(&theRect);
        stringRef = CFStringCreateWithPascalString(NULL, menuItemString,
                                                  kCFStringEncodingMacRoman);

        SetRect(&textBoxRect, theRect.left, 7, theRect.right, 22);
        DrawThemeTextBox(stringRef, kThemeSmallSystemFont, true, true, &textBoxRect, teJustCenter,
                          NULL);
        if(stringRef != NULL)
            CFRelease(stringRef);

        result = noErr;
    }

    return result;
}

// *****
```

## Demonstration Program CarbonEvents1 Comments

When this program is run, the user should

- Drag, resize, zoom and, when done, close the window.
- Send the application to the background and bring it to the foreground, noting the activation and deactivation of the pop-up menu button control.



- Choose items in the pop-up menu button's menu.
- Quit the application by choosing the Quit item in the Mac OS 9 File/Mac OS X Application menu and using its Command-key equivalent.

### **main**

If the program is running on OS 8/9, `SetMenuItemCommandID` is called to assign the command ID 'quit' to the Quit item in the File menu. (This command is assigned to the Mac OS X Quit item by default.) Thus, when the Quit item is chosen on Mac OS 8/9 and Mac OS X, the standard application event handler will call the default Quit Application Apple event handler (automatically installed when `RunApplicationEventLoop` is called) to close down the program.

The standard application event handler is installed when `RunApplicationEventLoop` is called. The standard application event handler handles all application events, including, in Classic event model parlance, suspend and resume events (that is, application-deactivated and application-activated events).

### **doNewWindow**

After the window is created, `ChangeWindowAttributes` is called to set the standard handler attribute, causing the standard window event handler to be installed on the window. The standard window event handles all window dragging, sizing, zooming, collapsing/minimizing, and closing operations, attends to control updating, and (provided a root control is created for the window), control deactivation and activation when the program is sent to the back and brought to the. It also calls `TrackControl` when a mouse-down occurs in the pop-up menu button, thus handling all user interaction with the control.

The call to `InstallWindowEventHandler` installs the application's window event handler on the window. A single event type (`kEventControlHit`) is registered. Note that this handler could have been installed on the control itself, but is installed on the window in this program for the purpose of emphasizing the propagation order of events. (No handler is installed on the control, so the event will "fall through" to the window event handler.)

If the program is running on Mac OS 8/9, `CreateRootControl` is called to create a root control for the window. (This call is not necessary on Mac OS X because, on Mac OS X, a root control is automatically created on windows that have at least one control.)

### **windowEventHandler**

`windowEventHandler` is a callback function. It is the window event handler installed on the window by the call to `InstallWindowEventHandler` in main. Its purpose is to determine the control value of the pop-up menu button control, and thus the menu item the user chose.

As previously stated, the standard window event handler calls `TrackControl` when a mouse-down occurs in the pop-up menu button. The Carbon Event Manager sends the `kEventControlHit` event type when `TrackControl` returns (regardless, incidentally, of whether the cursor is still within the control when the mouse button is released).

GetEventType is called to get the event type. If the event type is kEventControlHit, the if block executes and the handler returns noErr, indicating to the Carbon Event Manager that the event has been fully handled and that it should not be propagated further. If the event type is not kEventControlHit, the handler returns eventNotHandledErr, indicating that the event should be propagated further.

Within the if block, GetEventParameter is called to extract certain data from the event, specifically, a reference to the control. This reference is passed in the call to GetControlData, which gets a reference to the control's menu. The call to GetControlValue then gets the control's value, and the call to GetMenuItemText gets the text of the menu item. This text is then drawn at the top of the window to prove that the handler has done its job.

## Demonstration Program CarbonEvents2 Listing

```
// *****
// CarbonEvents2.h                                CARBON EVENT MODEL
// *****
//
// This program allows the user to:
//
// • Open, close, and interact with kWindowFullZoomGrowDocumentProc windows containing
//   various controls.
//
// • Open, close and interact with a movable modal dialog and, on Mac OS X only,
//   window-modal (sheet) alerts and window-modal (sheet) dialogs.
//
// The program demonstrates the main aspects of the Carbon Event model, specifically:
//
// • Events relating to menus, windows and controls, including the detection of mouse-downs
//   in controls in document windows and movable modal dialogs.
//
// • Keyboard events.
//
// • Events relating to application activation and deactivation (resume and suspend in
//   Classic event model parlance).
//
// • The use of mouse-moved events in support of cursor adjustment functions.
//
// • The installation of event loop timers (used, in this program, to trigger an "idle"
//   function.
//
// The program also demonstrates the implementation of live window resizing.
//
// The window contains a window header frame in which is displayed the menu items chosen from
// pop-up menu buttons, the identity of a push button when that push button is clicked, and
// scroll bar control values when the scroll arrows or gray areas/track of the scroll bars are
// clicked and when the scroll box/scroller is dragged. (The vertical scroll bar is the
// non-live feedback variant. The horizontal scroll bar is the live-feedback variant.) Text
// extracted from the edit text item in the window-modal (sheet) dialog and the identity of
// the button clicked in the window-modal (sheet) alert are also displayed in the window
// header frame.
//
```

```

// The movable modal dialog serves the secondary purpose of proving window correct window
// updating even though an event filter function is not used by the dialog.
//
// The program utilizes the following resources:
//
// • A 'plst' resource.
//
// • An 'MBAR' resource, and 'MENU' resources for OS9Apple/Application, File, Edit, and
//   Typing Target, and Dialogs menus, and the pop-up menus (preload, non-purgeable).
//
// • A 'WIND' resource (purgeable) (initially not visible).
//
// • A 'DLOG' resource ((purgeable) (initially not visible), with associated 'DITL', 'dlgx'
//   and 'dfnt' resources, for the window-modal (sheet) dialog.
//
// • A 'CNTL' resource (purgeable) for an image well control in the window-modal (sheet)
//   dialog.
//
// • A 'STR#' resource (purgeable) containing text for the window-modal (sheet) alert.
//
// • A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenubar          128
#define rWindow           128
#define rAboutDialog      128
#define mAppleApplication 128
#define iAbout            1
#define mFile             129
#define iQuit             12
#define iNew              1
#define iClose            4
#define mTyping           131
#define iDocument         1
#define iEditTextControl  2
#define iAllOfTheAbove    3
#define mDialogs          132
#define iMovableModal     1
#define iSheetAlert       2
#define iSheetDialog      3
#define mWindow           135
#define rSheetDialog      128
#define rSheetStrings     128
#define sAlertSheetMessage 1
#define sAlertSheetInformative 2
#define kPopupCountryID   'ctry'

```

```

#define kScrollBarWidth          15
#define MIN(a,b)                 ((a) < (b) ? (a) : (b))
#define topLeft(r)                (((Point *) &(r))[0])
#define botRight(r)              (((Point *) &(r))[1])

// ..... typedefs

typedef struct
{
    ControlRef popupTimeZoneRef;
    ControlRef popupCountryRef;
    ControlRef radiobuttonRedRef;
    ControlRef radiobuttonWhiteRef;
    ControlRef radiobuttonBlueRef;
    ControlRef groupBoxColorRef;
    ControlRef groupBoxTypingRef;
    ControlRef buttonRef;
    ControlRef buttonDefaultRef;
    ControlRef editTextRef;
    ControlRef scrollbarVertRef;
    ControlRef scrollbarHorizRef;
} docStruc, **docStrucHandle;

// ..... function prototypes

void          main                (void);
void          doPreliminaries     (void);
OSStatus      appEventHandler     (EventHandlerCallRef,EventRef,void *);
OSStatus      windowEventHandler  (EventHandlerCallRef,EventRef,void *);
void          doNewWindow         (void);
EventHandlerUPP doGetHandlerUPP    (void);
void          doCloseWindow       (WindowRef);
void          doGetControls       (WindowRef);
void          doIdle              (void);
void          doAdjustMenus       (void);
void          doMenuChoice        (MenuID,MenuItemIndex);
void          doDrawContent       (WindowRef);
void          doActivateDeactivate (WindowRef,Boolean);
void          doControlHit1       (WindowRef,ControlRef,Point,ControlPartCode);
void          doControlHit2       (void);
void          doPopupMenuChoice   (WindowRef,ControlRef,SInt16);
void          doVertScrollbar     (ControlPartCode,WindowRef,ControlRef,Point);
void          actionFunctionVert  (ControlRef,ControlPartCode);
void          actionFunctionHoriz (ControlRef,ControlPartCode);
void          doMoveScrollBar     (ControlRef,SInt16);
void          doRadioButtons      (ControlRef,WindowRef);
void          doCheckboxes        (ControlRef);
void          doPushButtons       (ControlRef,WindowRef);
void          doAdjustScrollBars  (WindowRef);
void          doAdjustCursor      (WindowRef);
void          doDrawDocumentTyping (SInt8,UInt32);
void          doDrawMessage       (WindowRef,Boolean);
void          doConcatPStrings    (Str255,Str255);
void          doCopyPString       (Str255,Str255);

```

```

OSStatus      doSheetAlert      (void);
OSStatus      doSheetDialog     (void);
EventHandlerUPP doGetSheetHandlerUPP (void);
OSStatus      sheetEventHandler (EventHandlerCallRef,EventRef,void *);
OSStatus      doMovableModalDialog (void);
EventHandlerUPP doGetDialogHandlerUPP (void);
OSStatus      dialogEventHandler (EventHandlerCallRef,EventRef,void *);

// *****
// CarbonEvents2.c
// *****

// ..... includes

#include "CarbonEvents2.h"

// ..... global variables

ControlActionUPP gActionFunctionVertUPP;
ControlActionUPP gActionFunctionHorizUPP;
Boolean          gRunningOnX = false;
SInt16           gNumberOfWindows = 0;
Str255           gCurrentString;
SInt16           gTypingTarget = 3;

// ***** main

void main(void)
{
    MenuBarHandle    menubarHdl;
    SInt32           response;
    MenuRef           menuRef;
    EventLoopTimerUPP eventLoopTimerUPP;
    EventTypeSpec     applicationEvents[] = { { kEventClassApplication, kEventAppActivated },
                                              { kEventClassCommand,      kEventProcessCommand },
                                              { kEventClassMenu,         kEventMenuEnableItems },
                                              { kEventClassMouse,        kEventMouseMoved } };

    // ..... do preliminaries

    doPreliminaries();

    // ..... create universal procedure pointers

    gActionFunctionVertUPP = NewControlActionUPP((ControlActionProcPtr) actionFunctionVert);
    gActionFunctionHorizUPP = NewControlActionUPP((ControlActionProcPtr) actionFunctionHoriz);

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMenubar);
    if(menubarHdl == NULL)
        ExitToShell();
    SetMenuBar(menubarHdl);

```

```

CreateStandardWindowMenu(0,&menuRef);
SetMenuID(menuRef,mWindow);
InsertMenu(menuRef,0);

DrawMenuBar();

Gestalt(gestaltMenuMgrAttr,&response);
if(response & gestaltMenuMgrAquaLayoutMask)
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
    {
        DeleteMenuItem(menuRef,iQuit);
        DeleteMenuItem(menuRef,iQuit - 1);
    }

    gRunningOnX = true;
}
else
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
        SetMenuItemCommandID(menuRef,iQuit,kHICommandQuit);

    menuRef = GetMenuRef(mDialogs);
    if(menuRef != NULL)
    {
        DisableMenuItem(menuRef,iSheetAlert);
        DisableMenuItem(menuRef,iSheetDialog);
    }
}

// ..... initial advisory text for window header
doCopyPString("\pManipulate the window and controls. Do typing.",gCurrentString);

// ..... install application event handler
InstallApplicationEventHandler(NewEventHandlerUPP((EventHandlerProcPtr) appEventHandler),
    GetEventTypeCount(applicationEvents),applicationEvents,
    0,NULL);

// ..... install timer
eventLoopTimerUPP = NewEventLoopTimerUPP((EventLoopTimerProcPtr) doIdle);
InstallEventLoopTimer(GetCurrentEventLoop(),0,TicksToEventTime(GetCaretTime()),
    eventLoopTimerUPP,NULL,NULL);

// ..... open window
doNewWindow();

```

```

// ..... run application event loop

RunApplicationEventLoop();
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(128);
    InitCursor();
}

// ***** appEventHandler

OSStatus appEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                        void * userData)
{
    OSStatus      result = eventNotHandledErr;
    UInt32        eventClass;
    UInt32        eventKind;
    HICommand      hiCommand;
    MenuID         menuID;
    MenuItemIndex  menuItem;
    WindowClass    windowClass;

    eventClass = GetEventClass(eventRef);
    eventKind  = GetEventKind(eventRef);

    switch(eventClass)
    {
    case kEventClassApplication:
        if(eventKind == kEventAppActivated)
            SetThemeCursor(kThemeArrowCursor);
        break;

    case kEventClassCommand:
        if(eventKind == kEventProcessCommand)
        {
            GetEventParameter(eventRef, kEventParamDirectObject, typeHICommand, NULL,
                             sizeof(HICommand), NULL, &hiCommand);
            if(hiCommand.commandID == kHICommandQuit)
                result = eventNotHandledErr;
            menuID = GetMenuID(hiCommand.menu.menuRef);
            menuItem = hiCommand.menu.menuItemIndex;
            if((hiCommand.commandID != kHICommandQuit) &&
                (menuID >= mAppleApplication && menuID <= mDialogs))
            {
                doMenuChoice(menuID, menuItem);
                result = noErr;
            }
        }
        if(hiCommand.commandID == kPopupCountryID)

```



```

        {
            doControlHit2();
            result = noErr;
        }
    }
    break;

case kEventClassMenu:
    if(eventKind == kEventMenuEnableItems)
    {
        GetWindowClass(FrontWindow(), &windowClass);
        if(windowClass == kDocumentWindowClass)
            doAdjustMenus();
        result = noErr;
    }
    break;

case kEventClassMouse:
    if(eventKind == kEventMouseMoved)
    {
        GetWindowClass(FrontWindow(), &windowClass);
        if(windowClass == kDocumentWindowClass)
            doAdjustCursor(FrontWindow());
        result = noErr;
    }
    break;
}

return result;
}

// ***** windowEventHandler

OSStatus windowEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                           void* userData)
{
    OSStatus      result = eventNotHandledErr;
    UInt32        eventClass;
    UInt32        eventKind;
    WindowRef     windowRef;
    Rect          mainScreenRect, portRect;
    BitMap        screenBits;
    Point         idealHeightAndWidth, minimumHeightAndWidth, mouseLocation;
    ControlRef     controlRef;
    ControlPartCode controlPartCode;
    SInt8         charCode;
    UInt32        modifiers;
    HICommand      hiCommand;

    eventClass = GetEventClass(eventRef);
    eventKind = GetEventKind(eventRef);

    switch(eventClass)
    {
        case kEventClassWindow:                                     // event class window

```

```

GetEventParameter(eventRef, kEventParamDirectObject, typeWindowRef, NULL, sizeof(windowRef),
                  NULL, &windowRef);

switch(eventKind)
{
    case kEventWindowDrawContent:
        doDrawContent(windowRef);
        break;

    case kEventWindowActivated:
        doActivateDeactivate(windowRef, true);
        break;

    case kEventWindowDeactivated:
        doActivateDeactivate(windowRef, false);
        break;

    case kEventWindowGetIdealSize:
        mainScreenRect = GetQDGlobalsScreenBits(&screenBits)->bounds;
        idealHeightAndWidth.v = mainScreenRect.bottom - 75;
        idealHeightAndWidth.h = 600;
        SetEventParameter(eventRef, kEventParamDimensions, typeQDPoint,
                          sizeof(idealHeightAndWidth), &idealHeightAndWidth);

        result = noErr;
        break;

    case kEventWindowGetMinimumSize:
        minimumHeightAndWidth.v = 308;
        minimumHeightAndWidth.h = 290;
        SetEventParameter(eventRef, kEventParamDimensions, typeQDPoint,
                          sizeof(minimumHeightAndWidth), &minimumHeightAndWidth);

        result = noErr;
        break;

    case kEventWindowZoomed:
        GetWindowPortBounds(windowRef, &portRect);
        EraseRect(&portRect);
        doAdjustScrollBars(windowRef);
        result = noErr;
        break;

    case kEventWindowBoundsChanged:
        doAdjustScrollBars(windowRef);
        doDrawMessage(windowRef, true);
        result = noErr;
        break;

    case kEventWindowClose:
        doCloseWindow(windowRef);
        break;
}
break;

```

```

case kEventClassControl:                                     // event class control
{
    switch(eventKind)
    {
        case kEventControlClick:
            GetEventParameter(eventRef, kEventParamMouseLocation, typeQDPoint, NULL,
                               sizeof(mouseLocation), NULL, &mouseLocation);
            SetPortWindowPort(FrontWindow());
            GlobalToLocal(&mouseLocation);
            controlRef = FindControlUnderMouse(mouseLocation, FrontWindow(), &controlPartCode);
            if(controlRef)
            {
                doControlHit1(FrontWindow(), controlRef, mouseLocation, controlPartCode);
                result = noErr;
            }
            break;
    }
    break;

case kEventClassKeyboard:                                   // event class keyboard
{
    switch(eventKind)
    {
        case kEventRawKeyDown:
            if(gTypingTarget == 1 || gTypingTarget == 3)
            {
                GetEventParameter(eventRef, kEventParamKeyMacCharCodes, typeChar, NULL,
                                   sizeof(charCode), NULL, &charCode);
                GetEventParameter(eventRef, kEventParamKeyModifiers, typeUInt32, NULL,
                                   sizeof(modifiers), NULL, &modifiers);
                doDrawDocumentTyping(charCode, modifiers);
            }
            if(gTypingTarget == 1)
                result = noErr;
            break;
    }
    break;

case kEventClassCommand:                                    // event class command
{
    if(eventKind == kEventProcessCommand)
    {
        GetEventParameter(eventRef, kEventParamDirectObject, typeHICCommand, NULL,
                           sizeof(HICCommand), NULL, &hiCommand);
        if(hiCommand.commandID == kHICCommandOK)
            doCopyPString("\pOK button hit", gCurrentString);
        if(hiCommand.commandID == kHICCommandCancel)
            doCopyPString("\pCancel button hit", gCurrentString);
        if(hiCommand.commandID == kHICCommandOther)
            doCopyPString("\pOther button hit", gCurrentString);
        GetWindowPortBounds(FrontWindow(), &portRect);
        InvalWindowRect(FrontWindow(), &portRect);
    }
    break;
}

return result;
}

```

```
// ***** doNewWindow

void doNewWindow(void)
{
    WindowRef      windowRef;
    Str255          windowTitleString = "\pCarbonEvents2 - ";
    Str255          theString;
    docStrucHandle docStrucHdl;
    SInt16          a;
    MenuRef          menuRef;
    EventTypeSpec   windowEvents[] = { { kEventClassWindow, kEventWindowDrawContent },
                                        { kEventClassWindow, kEventWindowActivated },
                                        { kEventClassWindow, kEventWindowDeactivated },
                                        { kEventClassWindow, kEventWindowGetIdealSize },
                                        { kEventClassWindow, kEventWindowGetMinimumSize },
                                        { kEventClassWindow, kEventWindowZoomed },
                                        { kEventClassWindow, kEventWindowBoundsChanged },
                                        { kEventClassWindow, kEventWindowClose },
                                        { kEventClassControl, kEventControlClick },
                                        { kEventClassKeyboard, kEventRawKeyDown },
                                        { kEventClassCommand, kEventProcessCommand } };

    // ..... open window and set attributes

    if(!(windowRef = GetNewCWindow(rWindow,NULL,(WindowRef) -1)))
        ExitToShell();

    ChangeWindowAttributes(windowRef,kWindowStandardHandlerAttribute,0);
    if(gRunningOnX)
        ChangeWindowAttributes(windowRef,kWindowLiveResizeAttribute,0);

    // ..... alternative open window and set attributes

    // Rect          contentRect = { 100,100,405,393 };
    // WindowAttributes  attributes = kWindowStandardHandlerAttribute |
    //                               kWindowStandardDocumentAttributes |
    //                               kWindowLiveResizeAttribute;
    //
    // CreateNewWindow(kDocumentWindowClass,attributes,&contentRect,&windowRef);
    // RepositionWindow(windowRef,NULL,kWindowAlertPositionOnMainScreen);

    // ..... get block for document structure, assign handle to window record refCon field

    if(!(docStrucHdl = (docStrucHandle) NewHandle(sizeof(docStruc))))
        ExitToShell();

    // ..... set window title

    SetWRefCon(windowRef,(SInt32) docStrucHdl);
    gNumberOfWindows ++;
    NumToString(gNumberOfWindows,theString);
    doConcatPStrings(windowTitleString,theString);
    SetWTitle(windowRef,windowTitleString);

    SetPortWindowPort(windowRef);
    TextSize(46);
}
```

```

// ..... if running on Mac OS 8/9, set theme-compliant color/pattern
SetThemeWindowBackground(windowRef,kThemeBrushDialogBackgroundActive,false);

// ..... install window event handler
InstallWindowEventHandler(windowRef,doGetHandlerUPP(),GetEventTypeCount(windowEvents),
    windowEvents,0,NULL);

// ..... get controls, adjust scroll bars, and show window
doGetControls(windowRef);
doAdjustScrollBars(windowRef);
ShowWindow(windowRef);

// ..... enable Typing and Window menu, fix typing target and keyboard focus
menuRef = GetMenuRef(mTyping);
EnableMenuItem(menuRef,0);

for(a = iDocument;a <= iAllOfTheAbove;a ++){
    CheckMenuItem(menuRef,a,false);
    CheckMenuItem(menuRef,iAllOfTheAbove,true);
    SetKeyboardFocus(windowRef,(*docStrucHdl)->editTextRef,kControlFocusNextPart);
    gTypingTarget = 3;

    EnableMenuItem(GetMenuRef(mWindow),0);
}

// ***** doGetHandlerUPP
EventHandlerUPP doGetHandlerUPP(void)
{
    static EventHandlerUPP windowEventHandlerUPP;

    if(windowEventHandlerUPP == NULL)
        windowEventHandlerUPP = NewEventHandlerUPP((EventHandlerProcPtr) windowEventHandler);

    return windowEventHandlerUPP;
}

// ***** doCloseWindow
void doCloseWindow(WindowRef windowRef)
{
    docStrucHandle docStrucHdl;

    KillControls(windowRef);

    docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));
    DisposeHandle((Handle) docStrucHdl);

    gNumberOfWindows --;

```

```

    if(gNumberOfWindows == 0)
    {
        DisableMenuItem(GetMenuRef(mTyping),0);
        DisableMenuItem(GetMenuRef(mWindow),0);
    }
}

// ***** doGetControls

void doGetControls(WindowRef windowRef)
{
    ControlRef    controlRef;
    docStrucHandle docStrucHdl;
    OSStatus      osError;
    Rect          controlRect;
    Boolean       booleanData = true;

    CreateRootControl(windowRef,&controlRef);

    docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));

    SetRect(&controlRect,40,40,235,60);
    if((osError = CreatePopupButtonControl(windowRef,&controlRect,CFSTR("Time Zone:"),133,false,
                                           -1,0,0,&(*docStrucHdl)->popupTimeZoneRef)) != noErr)
        ExitToShell();

    SetRect(&controlRect,55,73,235,93);
    if((osError = CreatePopupButtonControl(windowRef,&controlRect,CFSTR("Country:"),134,false,
                                           -1,0,0,&(*docStrucHdl)->popupCountryRef)) != noErr)
        ExitToShell();

    SetRect(&controlRect,35,126,91,144);
    if((osError = CreateRadioButtonControl(windowRef,&controlRect,CFSTR("Red"),1,false,
                                           &(*docStrucHdl)->radiobuttonRedRef)) != noErr)
        ExitToShell();

    SetRect(&controlRect,35,148,91,166);
    if((osError = CreateRadioButtonControl(windowRef,&controlRect,CFSTR("White"),0,false,
                                           &(*docStrucHdl)->radiobuttonWhiteRef)) != noErr)
        ExitToShell();

    SetRect(&controlRect,35,170,91,188);
    if((osError = CreateRadioButtonControl(windowRef,&controlRect,CFSTR("Blue"),0,false,
                                           &(*docStrucHdl)->radiobuttonBlueRef)) != noErr)
        ExitToShell();

    SetRect(&controlRect,20,102,107,201);
    if((osError = CreateGroupBoxControl(windowRef,&controlRect,CFSTR("Color"),true,
                                       &(*docStrucHdl)->groupboxColorRef)) != noErr)
        ExitToShell();

    SetRect(&controlRect,123,102,255,201);
    if((osError = CreateGroupBoxControl(windowRef,&controlRect,CFSTR("Typing"),true,
                                       &(*docStrucHdl)->groupboxTypingRef)) != noErr)
        ExitToShell();
}

```

```

SetRect(&controlRect,63,213,132,233);
if((osError = CreatePushButtonControl(windowRef,&controlRect,CFSTR("Cancel"),
                                     &(*docStrucHdl)->buttonRef)) != noErr)
    ExitToShell();

SetRect(&controlRect,144,213,213,233);
if((osError = CreatePushButtonControl(windowRef,&controlRect,CFSTR("OK"),
                                     &(*docStrucHdl)->buttonDefaultRef)) != noErr)
    ExitToShell();

SetRect(&controlRect,26,251,249,267);
if((osError = CreateEditTextControl(windowRef,&controlRect,NULL,false,true,NULL,
                                    &(*docStrucHdl)->editTextRef)) != noErr)
    ExitToShell();

SetRect(&controlRect,0,0,16,262);
if((osError = CreateScrollBarControl(windowRef,&controlRect,0,0,125,0,false,NULL,
                                    &(*docStrucHdl)->scrollbarVertRef)) != noErr)
    ExitToShell();

SetRect(&controlRect,0,0,245,16);
if((osError = CreateScrollBarControl(windowRef,&controlRect,0,0,125,0,true,NULL,
                                    &(*docStrucHdl)->scrollbarHorizRef)) != noErr)
    ExitToShell();

AutoEmbedControl((*docStrucHdl)->radiobuttonRedRef>windowRef);
AutoEmbedControl((*docStrucHdl)->radiobuttonWhiteRef>windowRef);
AutoEmbedControl((*docStrucHdl)->radiobuttonBlueRef>windowRef);

SetControlCommandID((*docStrucHdl)->popupCountryRef,kPopupCountryID);

SetControlData((*docStrucHdl)->buttonDefaultRef,kControlEntireControl,
               kControlPushButtonDefaultTag,sizeof(booleanData),&booleanData);
}

// ***** doIdle

void doIdle(void)
{
    if(!gRunningOnX)
        IdleControls(FrontWindow());
}

// ***** doAdjustMenus

void doAdjustMenus(void)
{
    MenuRef    menuRef;
    OSStatus  osError;
    WindowRef windowRef;

```



```

    if(FrontWindow())
    {
        menuRef = GetMenuRef(mFile);
        EnableMenuItem(menuRef,iClose);
        menuRef = GetMenuRef(mTyping);
        EnableMenuItem(menuRef,0);
    }
    else
    {
        menuRef = GetMenuRef(mFile);
        DisableMenuItem(menuRef,iClose);
        menuRef = GetMenuRef(mTyping);
        DisableMenuItem(menuRef,0);
    }

    if(gRunningOnX)
    {
        if((osError = GetSheetWindowParent(FrontWindow(),&windowRef)) == noErr)
        {
            menuRef = GetMenuRef(mFile);
            DisableMenuItem(menuRef,iClose);
            menuRef = GetMenuRef(mTyping);
            DisableMenuItem(menuRef,0);
        }
        else
        {
            if(FrontWindow())
            {
                menuRef = GetMenuRef(mTyping);
                EnableMenuItem(menuRef,0);
            }
        }

        menuRef = GetMenuRef(mDialogs);
        if((osError = GetSheetWindowParent(FrontWindow(),&windowRef)) == noErr) ||
            (FrontWindow() == NULL) || IsWindowCollapsed(FrontWindow()))
        {
            DisableMenuItem(menuRef,iSheetAlert);
            DisableMenuItem(menuRef,iSheetDialog);
        }
        else
        {
            EnableMenuItem(menuRef,iSheetAlert);
            EnableMenuItem(menuRef,iSheetDialog);
        }
    }
}

// ***** doMenuChoice

void doMenuChoice(MenuID menuID,MenuItemIndex menuItem)
{
    WindowRef      windowRef;
    SInt16          a;
    MenuRef         menuRef;
    docStrucHandle docStrucHdl;

```

```

if(menuID == 0)
    return;

windowRef = FrontWindow();

switch(menuID)
{
    case mAppleApplication:
        if(menuItem == iAbout)
            SysBeep(10);
        break;

    case mFile:
        if(menuItem == iNew)
            doNewWindow();
        else if(menuItem == iClose)
        {
            doCloseWindow(windowRef);
            DisposeWindow(windowRef);
        }
        break;

    case mTyping:
        menuRef = GetMenuRef(mTyping);
        for(a = iDocument; a <= iAllOfTheAbove; a++)
            CheckMenuItem(menuRef, a, false);
        CheckMenuItem(menuRef, menuItem, true);
        gTypingTarget = menuItem;
        docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));
        if(menuItem == iDocument)
            SetKeyboardFocus(windowRef, (*docStrucHdl)->editTextRef, kControlFocusNoPart);
        else
            SetKeyboardFocus(windowRef, (*docStrucHdl)->editTextRef, kControlFocusNextPart);
        break;

    case mDialogs:
        if(menuItem == iMovableModal)
            if(doMovableModalDialog() != noErr)
                ExitToShell();
        if(menuItem == iSheetAlert)
            if(doSheetAlert() != noErr)
                ExitToShell();
        if(menuItem == iSheetDialog)
            if(doSheetDialog() != noErr)
                ExitToShell();
        break;
}
}

// ***** doDrawContent

void doDrawContent(WindowRef windowRef)
{
    SetPortWindowPort(windowRef);
    doDrawMessage(windowRef, windowRef == FrontWindow());
}

```

```
// ***** doActivateWindow

void doActivateDeactivate(WindowRef windowRef, Boolean becomingActive)
{
    if(becomingActive)
        doDrawMessage(windowRef, becomingActive);
    else
        doDrawMessage(windowRef, becomingActive);
}

// ***** doControlHit1

void doControlHit1(WindowRef windowRef, ControlRef controlRef, Point mouseLocation,
                  ControlPartCode controlPartCode)
{
    docStrucHandle docStrucHdl;
    SInt16          controlValue;

    docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));

    if(controlRef == (*docStrucHdl)->popupTimeZoneRef)
    {
        TrackControl(controlRef, mouseLocation, (ControlActionUPP) -1);
        controlValue = GetControlValue(controlRef);
        doPopupMenuChoice(windowRef, controlRef, controlValue);
    }
    else if(controlRef == (*docStrucHdl)->scrollbarVertRef)
    {
        doVertScrollbar(controlPartCode, windowRef, controlRef, mouseLocation);
    }
    else if(controlRef == (*docStrucHdl)->scrollbarHorizRef)
    {
        TrackControl(controlRef, mouseLocation, gActionFunctionHorizUPP);
    }
    else
    {
        if(TrackControl(controlRef, mouseLocation, NULL))
        {
            if(controlRef == (*docStrucHdl)->radiobuttonRedRef ||
               controlRef == (*docStrucHdl)->radiobuttonWhiteRef ||
               controlRef == (*docStrucHdl)->radiobuttonBlueRef)
            {
                doRadioButtons(controlRef, windowRef);
            }
            if(controlRef == (*docStrucHdl)->buttonRef ||
               controlRef == (*docStrucHdl)->buttonDefaultRef)
            {
                doPushButtons(controlRef, windowRef);
            }
        }
    }
}
}
```

```
// ***** doControlHit2
```

```
void doControlHit2(void)
{
    docStrucHandle docStrucHdl;
    ControlRef      controlRef;
    SInt16          controlValue;

    docStrucHdl = (docStrucHandle) GetWRefCon(FrontWindow());
    controlRef = (*docStrucHdl)->popupCountryRef;

    controlValue = GetControlValue(controlRef);
    doPopupMenuChoice(FrontWindow(),controlRef,controlValue);
}
```

```
// ***** doPopupMenuChoice
```

```
void doPopupMenuChoice(WindowRef windowRef,ControlRef controlRef,SInt16 controlValue)
{
    MenuRef menuRef;
    Size     actualSize;

    GetControlData(controlRef,kControlEntireControl,kControlPopupMenuHandleTag,
                    sizeof(menuRef),&menuRef,&actualSize);
    GetMenuItemText(menuRef,controlValue,gCurrentString);
    doDrawMessage(windowRef,true);
}
```

```
// ***** doVertScrollbar
```

```
void doVertScrollbar(ControlPartCode controlPartCode,WindowRef windowRef,
                    ControlRef controlRef,Point mouseXY)
{
    Str255 valueString;

    doCopyPString("\pScroll Bar Control Value: ",gCurrentString);

    switch(controlPartCode)
    {
        case kControlIndicatorPart:
            if(TrackControl(controlRef,mouseXY,NULL))
            {
                NumToString((SInt32) GetControlValue(controlRef),valueString);
                doConcatPStrings(gCurrentString,valueString);
                doDrawMessage(windowRef,true);
            }
            break;

        case kControlUpButtonPart:
        case kControlDownButtonPart:
        case kControlPageUpPart:
        case kControlPageDownPart:
            TrackControl(controlRef,mouseXY,gActionFunctionVertUPP);
            break;
    }
}
```

```

// ***** actionFunctionVert

void actionFunctionVert(ControlRef controlRef,ControlPartCode controlPartCode)
{
    SInt16    scrollDistance, controlValue;
    Str255    valueString;
    WindowRef windowRef;

    doCopyPString("\pScroll Bar Control Value: ",gCurrentString);

    if(controlPartCode)
    {
        switch(controlPartCode)
        {
            case kControlUpButtonPart:
            case kControlDownButtonPart:
                scrollDistance = 2;
                break;

            case kControlPageUpPart:
            case kControlPageDownPart:
                scrollDistance = 55;
                break;
        }

        if((controlPartCode == kControlDownButtonPart) ||
            (controlPartCode == kControlPageDownPart))
            scrollDistance = -scrollDistance;

        controlValue = GetControlValue(controlRef);
        if(((controlValue == GetControlMaximum(controlRef)) && scrollDistance < 0) ||
            ((controlValue == GetControlMinimum(controlRef)) && scrollDistance > 0))
            return;

        doMoveScrollBar(controlRef,scrollDistance);

        NumToString((SInt32) GetControlValue(controlRef),valueString);
        doConcatPStrings(gCurrentString,valueString);
        windowRef = GetControlOwner(controlRef);
        doDrawMessage(windowRef,true);
    }
}

// ***** actionFunctionHoriz

void actionFunctionHoriz(ControlRef controlRef,ControlPartCode controlPartCode)
{
    SInt16    scrollDistance, controlValue;
    Str255    valueString;
    WindowRef windowRef;

    doCopyPString("\pScroll Bar Control Value: ",gCurrentString);

```

```

if(controlPartCode != kControlIndicatorPart)
{
    switch(controlPartCode)
    {
        case kControlUpButtonPart:
        case kControlDownButtonPart:
            scrollDistance = 2;
            break;

        case kControlPageUpPart:
        case kControlPageDownPart:
            scrollDistance = 55;
            break;
    }

    if((controlPartCode == kControlDownButtonPart) ||
        (controlPartCode == kControlPageDownPart))
        scrollDistance = -scrollDistance;

    controlValue = GetControlValue(controlRef);
    if(((controlValue == GetControlMaximum(controlRef)) && scrollDistance < 0) ||
        ((controlValue == GetControlMinimum(controlRef)) && scrollDistance > 0))
        return;

    doMoveScrollBar(controlRef,scrollDistance);
}

NumToString((SInt32) GetControlValue(controlRef),valueString);
doConcatPStrings(gCurrentString,valueString);
windowRef = GetControlOwner(controlRef);
doDrawMessage(windowRef,true);
}

// ***** doMoveScrollBar

void doMoveScrollBar(ControlRef controlRef,SInt16 scrollDistance)
{
    SInt16 oldControlValue, controlValue, controlMax;

    oldControlValue = GetControlValue(controlRef);
    controlMax = GetControlMaximum(controlRef);

    controlValue = oldControlValue - scrollDistance;

    if(controlValue < 0)
        controlValue = 0;
    else if(controlValue > controlMax)
        controlValue = controlMax;

    SetControlValue(controlRef,controlValue);
}

```

```
// ***** doRadioButtons

void doRadioButtons(ControlRef controlRef, WindowRef windowRef)
{
    docStrucHandle docStrucHdl;

    docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));

    SetControlValue((*docStrucHdl)->radiobuttonRedRef, kControlRadioButtonUncheckedValue);
    SetControlValue((*docStrucHdl)->radiobuttonWhiteRef, kControlRadioButtonUncheckedValue);
    SetControlValue((*docStrucHdl)->radiobuttonBlueRef, kControlRadioButtonUncheckedValue);
    SetControlValue(controlRef, kControlRadioButtonCheckedValue);
}

// ***** doCheckboxes

void doCheckboxes(ControlRef controlRef)
{
    SetControlValue(controlRef, !GetControlValue(controlRef));
}

// ***** doPushButtons

void doPushButtons(ControlRef controlRef, WindowRef windowRef)
{
    docStrucHandle docStrucHdl;

    docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));

    if(controlRef == (*docStrucHdl)->buttonRef)
    {
        doCopyPString("\pCancel button", gCurrentString);
        doDrawMessage(windowRef, true);
    }
    else if(controlRef == (*docStrucHdl)->buttonDefaultRef)
    {
        doCopyPString("\pDefault button", gCurrentString);
        doDrawMessage(windowRef, true);
    }
}

// ***** doAdjustScrollBars

void doAdjustScrollBars(WindowRef windowRef)
{
    Rect portRect;
    docStrucHandle docStrucHdl;

    docStrucHdl = (docStrucHandle) (GetWRefCon(windowRef));

    GetWindowPortBounds(windowRef, &portRect);

    HideControl((*docStrucHdl)->scrollbarVertRef);
    HideControl((*docStrucHdl)->scrollbarHorizRef);
}
```

```

MoveControl((*docStrucHdl)->scrollbarVertRef,portRect.right - kScrollbarWidth,
            portRect.top + 25);
MoveControl((*docStrucHdl)->scrollbarHorizRef,portRect.left - 1,
            portRect.bottom - kScrollbarWidth);

SizeControl((*docStrucHdl)->scrollbarVertRef,16, portRect.bottom - 39);
SizeControl((*docStrucHdl)->scrollbarHorizRef, portRect.right - 13,16);

ShowControl((*docStrucHdl)->scrollbarVertRef);
ShowControl((*docStrucHdl)->scrollbarHorizRef);

SetControlMaximum((*docStrucHdl)->scrollbarVertRef,portRect.bottom - portRect.top - 25
                  - kScrollbarWidth);
SetControlMaximum((*docStrucHdl)->scrollbarHorizRef,portRect.right - portRect.left
                  - kScrollbarWidth);
}

// ***** doAdjustCursor

void doAdjustCursor(WindowRef windowRef)
{
    RgnHandle myArrowRegion;
    RgnHandle myIBeamRegion;
    Rect cursorRect;
    Point mousePt;
    ControlRef controlRef;
    Cursor arrow;

    myArrowRegion = NewRgn();
    myIBeamRegion = NewRgn();
    SetRectRgn(myArrowRegion, -32768, -32768, 32767, 32767);

    SetRect(&cursorRect, 24, 250, 254, 269);

    SetPortWindowPort(windowRef);
    LocalToGlobal(&topLeft(cursorRect));
    LocalToGlobal(&botRight(cursorRect));

    RectRgn(myIBeamRegion, &cursorRect);
    DiffRgn(myArrowRegion, myIBeamRegion, myArrowRegion);

    GetGlobalMouse(&mousePt);
    GetKeyboardFocus(FrontWindow(), &controlRef);

    if(PtInRgn(mousePt, myIBeamRegion) && controlRef)
        SetCursor(*(GetCursor(iBeamCursor)));
    else
        SetCursor(GetQDGlobalsArrow(&arrow));

    DisposeRgn(myArrowRegion);
    DisposeRgn(myIBeamRegion);
}

```



```
// ***** doDrawDocumentTyping
```

```
void doDrawDocumentTyping(SInt8 charCode, UInt32 modifiers)
{
    Rect        typingRect = { 118, 128, 194, 253 };
    Rect        shiftRect  = { 131, 181, 139, 189 };
    Rect        controlRect = { 144, 181, 152, 189 };
    Rect        optionRect  = { 157, 181, 165, 189 };
    Rect        cmdRect     = { 170, 181, 178, 189 };
    Rect        textBoxRect;
    CFStringRef stringRef;

    EraseRect(&typingRect);

    stringRef = CFStringCreateWithPascalString(NULL, "\pShift", kCFStringEncodingMacRoman);
    SetRect(&textBoxRect, 142, 132, 242, 147);
    if((modifiers & shiftKey) != 0) TextMode(srcOr); else TextMode(grayishTextOr);
    DrawThemeTextBox(stringRef, kThemeSmallSystemFont, 0, false, &textBoxRect, teJustLeft, NULL);

    stringRef = CFStringCreateWithPascalString(NULL, "\pControl", kCFStringEncodingMacRoman);
    SetRect(&textBoxRect, 142, 145, 242, 160);
    if((modifiers & controlKey) != 0) TextMode(srcOr); else TextMode(grayishTextOr);
    DrawThemeTextBox(stringRef, kThemeSmallSystemFont, 0, false, &textBoxRect, teJustLeft, NULL);

    stringRef = CFStringCreateWithPascalString(NULL, "\pOption", kCFStringEncodingMacRoman);
    SetRect(&textBoxRect, 142, 158, 242, 173);
    if((modifiers & optionKey) != 0) TextMode(srcOr); else TextMode(grayishTextOr);
    DrawThemeTextBox(stringRef, kThemeSmallSystemFont, 0, false, &textBoxRect, teJustLeft, NULL);

    stringRef = CFStringCreateWithPascalString(NULL, "\pCmd", kCFStringEncodingMacRoman);
    SetRect(&textBoxRect, 142, 171, 242, 186);
    if((modifiers & cmdKey) != 0) TextMode(srcOr); else TextMode(grayishTextOr);
    DrawThemeTextBox(stringRef, kThemeSmallSystemFont, 0, false, &textBoxRect, teJustLeft, NULL);

    if(stringRef != NULL)
        CFRelease(stringRef);

    TextMode(srcOr);
    MoveTo(205, 171);
    DrawChar(charCode);
}
```

```
// ***** doDrawMessage
```

```
void doDrawMessage(WindowRef windowRef, Boolean inState)
{
    Rect        portRect, headerRect, textBoxRect;
    CFStringRef stringRef;

    SetPortWindowPort(windowRef);

    GetWindowPortBounds(windowRef, &portRect);
```

```

SetRect(&headerRect,portRect.left - 1,portRect.top - 1,portRect.right + 1,
        portRect.top + 26);
DrawThemeWindowHeader(&headerRect,inState);

stringRef = CFStringCreateWithPascalString(NULL,gCurrentString,
                                           kCFStringEncodingMacRoman);
SetRect(&textBoxRect,portRect.left,5,portRect.right,25);

if(inState == kThemeStateActive)
    TextMode(srcOr);
else
    TextMode(grayishTextOr);

DrawThemeTextBox(stringRef,kThemeSmallSystemFont,inState,false,&textBoxRect,teJustCenter,
                 NULL);
if(stringRef != NULL)
    CFRelease(stringRef);
}

// ***** doConcatPStrings

void doConcatPStrings(Str255 targetString,Str255 appendString)
{
    SInt16 appendLength;

    appendLength = MIN(appendString[0],255 - targetString[0]);

    if(appendLength > 0)
    {
        BlockMoveData(appendString+1,targetString+targetString[0]+1,(SInt32) appendLength);
        targetString[0] += appendLength;
    }
}

// ***** doCopyPString

void doCopyPString(Str255 sourceString,Str255 destinationString)
{
    SInt16 stringLength;

    stringLength = sourceString[0];
    BlockMove(sourceString + 1,destinationString + 1,stringLength);
    destinationString[0] = stringLength;
}

// *****
// Dialogs.c
// *****

// ..... includes

#include "CarbonEvents2.h"

```

```

// ..... global variables

Boolean gSound   = 0;
Boolean gVideo   = 0;
Boolean gEffects = 0;

extern Str255 gCurrentString;

// ***** doSheetAlert

OSStatus doSheetAlert(void)
{
    AlertStdCFStringAlertParamRec paramRec;
    Str255                        messageText, informativeText;
    CFStringRef                  messageTextCF, informativeTextCF;
    OSStatus                     osError = noErr;
    DialogRef                    dialogRef;

    GetStandardAlertDefaultParams(&paramRec, kStdCFStringAlertVersionOne);
    paramRec.cancelText = CFSTR("Cancel");
    paramRec.otherText  = CFSTR("Other");

    GetIndString(messageText, rSheetStrings, sAlertSheetMessage);
    GetIndString(informativeText, rSheetStrings, sAlertSheetInformative);
    messageTextCF = CFStringCreateWithPascalString(NULL, messageText,
                                                    CFStringGetSystemEncoding());
    informativeTextCF = CFStringCreateWithPascalString(NULL, informativeText,
                                                       CFStringGetSystemEncoding());

    osError = CreateStandardSheet(kAlertCautionAlert, messageTextCF, informativeTextCF, &paramRec,
                                GetWindowEventTarget(FrontWindow()), &dialogRef);

    if(osError == noErr)
        osError = ShowSheetWindow(GetDialogWindow(dialogRef), FrontWindow());

    if(messageTextCF != NULL)
        CFRelease(messageTextCF);
    if(informativeTextCF != NULL)
        CFRelease(informativeTextCF);

    doAdjustMenus();

    return osError;
}

// ***** doSheetDialog

OSStatus doSheetDialog(void)
{
    DialogRef    dialogRef;
    WindowRef    windowRef;
    EventTypeSpec sheetEvents[] = { kEventClassMouse, kEventMouseDown };
    ControlRef    controlRef;
    Str255        stringData = "\pBradman";
    OSStatus      osError = noErr;

```

```

dialogRef = GetNewDialog(rSheetDialog,NULL,(WindowRef) -1);
windowRef = GetDialogWindow(dialogRef);
ChangeWindowAttributes(windowRef,kWindowStandardHandlerAttribute,0);

InstallWindowEventHandler(windowRef,doGetSheetHandlerUPP(),GetEventTypeCount(sheetEvents),
    sheetEvents,0,NULL);

SetDialogDefaultItem(dialogRef,kStdOkItemIndex);

GetDialogItemAsControl(dialogRef,2,&controlRef);
SetDialogItemText((Handle) controlRef,stringData);
SelectDialogItemText(dialogRef,2,0,32767);

osError = ShowSheetWindow(GetDialogWindow(dialogRef),FrontWindow());

doAdjustMenus();

return osError;
}

// ***** doGetSheetHandlerUPP

EventHandlerUPP doGetSheetHandlerUPP(void)
{
    static EventHandlerUPP sheetEventHandlerUPP;

    if(sheetEventHandlerUPP == NULL)
        sheetEventHandlerUPP = NewEventHandlerUPP((EventHandlerProcPtr) sheetEventHandler);

    return sheetEventHandlerUPP;
}

// ***** sheetEventHandler

OSStatus sheetEventHandler(EventHandlerCallRef eventHandlerCallRef,EventRef eventRef,
    void* userData)
{
    OSStatus      result = eventNotHandledErr;
    UInt32        eventClass;
    UInt32        eventKind;
    Point          mouseLocation;
    ControlRef     controlRef, controlRefOKButton;
    ControlPartCode controlPartCode;
    DialogRef      dialogRef;
    Rect           portRect;

    eventClass = GetEventClass(eventRef);
    eventKind = GetEventKind(eventRef);

    if(eventClass == kEventClassMouse)
    {
        if(eventKind == kEventMouseDown)
        {
            GetEventParameter(eventRef,kEventParamMouseLocation,typeQDPoint,NULL,
                sizeof(mouseLocation),NULL,&mouseLocation);

```

```

SetPortWindowPort(FrontWindow());
GlobalToLocal(&mouseLocation);
controlRef = FindControlUnderMouse(mouseLocation, FrontWindow(), &controlPartCode);
if(controlRef)
{
    dialogRef = GetDialogFromWindow(FrontWindow());
    GetDialogItemAsControl(dialogRef, 1, &controlRefOKButton);

    if(controlRef == controlRefOKButton)
    {
        GetDialogItemAsControl(dialogRef, 2, &controlRef);
        GetDialogItemText((Handle) controlRef, gCurrentString);

        HideSheetWindow(FrontWindow());
        DisposeDialog(dialogRef);

        GetWindowPortBounds(FrontWindow(), &portRect);
        InvalWindowRect(FrontWindow(), &portRect);

        return noErr;
    }
}
}

return result;
}

// ***** doMovableModalDialog

OSStatus doMovableModalDialog(void)
{
    OSStatus      osError = noErr;
    Rect          rect = { 0, 0, 167, 148 };
    WindowRef     windowRef;
    Rect          pushButtonRect = { 127, 63, 147, 132 };
    ControlRef     controlRef;
    ControlRef     soundControlRef, videoControlRef, effectsControlRef, boxControlRef;
    Rect          checkboxRect = { 37, 32, 55, 124 };
    ControlID      controlId;
    Rect          groupBoxRect = { 10, 16, 113, 132 };
    EventTypeSpec dialogEvents[] = { kEventClassControl, kEventControlHit };

    osError = CreateNewWindow(kMovableModalWindowClass, kWindowStandardHandlerAttribute, &rect,
                             &windowRef);

    if(osError == noErr)
    {
        RepositionWindow(windowRef, FrontWindow(), kWindowAlertPositionOnMainScreen);
        SetThemeWindowBackground(windowRef, kThemeBrushDialogBackgroundActive, false);

        CreateRootControl(windowRef, &controlRef);

        CreatePushButtonControl(windowRef, &pushButtonRect, CFSTR("OK"), &controlRef);
        SetWindowDefaultButton(windowRef, controlRef);
        controlId.id = 'okbt';
        SetControlID(controlRef, &controlID);
    }
}

```

```

CreateCheckBoxControl(windowRef,&checkboxRect,CFSTR("Sound On"),1,false,&soundControlRef);
controlID.id = 'chb1';
SetControlID(soundControlRef,&controlID);
SetControlValue(soundControlRef,gSound);

OffsetRect(&checkboxRect,0,22);
CreateCheckBoxControl(windowRef,&checkboxRect,CFSTR("Video On"),1,false,&videoControlRef);
controlID.id = 'chb2';
SetControlID(videoControlRef,&controlID);
SetControlValue(videoControlRef,gVideo);
OffsetRect(&checkboxRect,0,22);
CreateCheckBoxControl(windowRef,&checkboxRect,CFSTR("Effects On"),1,false,
                    &effectsControlRef);
controlID.id = 'chb3';
SetControlID(effectsControlRef,&controlID);
SetControlValue(effectsControlRef,gEffects);

CreateGroupBoxControl(windowRef,&groupboxRect,CFSTR("Preferences"),true,&boxControlRef);

AutoEmbedControl(soundControlRef>windowRef);
AutoEmbedControl(videoControlRef>windowRef);
AutoEmbedControl(effectsControlRef>windowRef);

InstallWindowEventHandler(windowRef,doGetDialogHandlerUPP(),
                        GetEventTypeCount(dialogEvents),dialogEvents>windowRef,NULL);
ShowWindow(windowRef);
osError = RunAppModalLoopForWindow(windowRef);
}

return osError;
}

// ***** doGetDialogHandlerUPP

EventHandlerUPP doGetDialogHandlerUPP(void)
{
    static EventHandlerUPP dialogEventHandlerUPP;

    if(dialogEventHandlerUPP == NULL)
        dialogEventHandlerUPP = NewEventHandlerUPP((EventHandlerProcPtr) dialogEventHandler);

    return dialogEventHandlerUPP;
}

// ***** dialogEventHandler

OSStatus dialogEventHandler(EventHandlerCallRef eventHandlerCallRef,EventRef eventRef,
                        void *userData)
{
    OSStatus result = eventNotHandledErr;
    UInt32 eventClass;
    UInt32 eventKind;
    ControlRef controlRef;
    ControlID controlID;

```

```

eventClass = GetEventClass(eventRef);
eventKind = GetEventKind(eventRef);

if(eventClass == kEventClassControl)
{
    if(eventKind == kEventControlHit)
    {
        GetEventParameter(eventRef, kEventParamDirectObject, typeControlRef, NULL,
                           sizeof(ControlRef), NULL, &controlRef);

        GetControlID(controlRef, &controlID);
        if(controlID.id == 'okbt')
        {
            QuitAppModalLoopForWindow(userData);
            DisposeWindow(userData);
            result = noErr;
        }
        else
        {
            SetControlValue(controlRef, !GetControlValue(controlRef));
            if(controlID.id == 'chb1')
                gSound = GetControlValue(controlRef);
            else if(controlID.id == 'chb2')
                gVideo = GetControlValue(controlRef);
            else if(controlID.id == 'chb3')
                gEffects = GetControlValue(controlRef);
            result = noErr;
        }
    }
}
return result;
}

// *****

```

## Demonstration Program CarbonEvents2 Comments

When this program is run, the user should

- Open and close windows, and drag, resize, and zoom open windows, noting particularly the size to which the window zooms in an out.
- Interact with the pop-up menu button, push button, and scrollbar controls in open windows.
- Send the application to the background and bring it to the foreground, noting the activation and deactivation of the window controls.
- Type into the edit text control, with and without the Shift, Control, Option, and/or Command keys held down. Then choose Document or Edit Text Control to change the target for keyboard input.



- Choose the items in the Dialogs menu to open, close, and interact with the movable modal dialog and, on Mac OS X only, window-modal (sheet) alerts and window-modal (sheet) dialogs.
- Quit the application by choosing the Quit item in the Mac OS 8/9 File/Mac OS X Application menu and using its Command-key equivalent.

The functions relating to controls in this program, including the action functions for the scroll bars, are similar to those in the demonstration programs Controls1 and Controls2 (Chapter 7).

## CarbonEvents2.c

### main

If the program is running on OS 8/9, `SetMenuItemCommandID` is called to assign the command ID 'quit' to the Quit item in the File menu. (This command is assigned to the Mac OS X Quit item by default.) Thus, when the Quit item is chosen on Mac OS 8/9 and Mac OS X, the standard application event handler will call the default Quit Application Apple event handler (automatically installed when `RunApplicationEventLoop` is called) to close down the program.

The call to `InstallApplicationEventHandler` installs the program's application event handler.

The call to `InstallEventLoopTimer` installs a timer set to fire at the interval returned by the call to `GetCaretTime`, which is converted to event time (seconds) by the macro `TicksToEventTime`. The timer will be used to trigger a call to the function `doIdle`, within which `IdleControls` is called to blink the insertion point caret in the windows' edit text control. A universal procedure pointer to `doIdle` is passed in the `inTimerProc` parameter.

When `RunApplicationEventLoop` is called, registered events will be dispatched to the application.

### appEventHandler

`appEventHandler` is the application's application event handler. It is a callback function.

The calls to `GetEventClass` and `GetEventKind` get the event class and type. The function then switches on the event class.

If the event class is `kEventClassApplication` and the event type is `kEventAppActivated`, the cursor is set to the arrow cursor. `eventNotHandledErr` is returned by the handler, ensuring that the event will be propagated to the standard application event handler.

If the event class is `kEventClassCommand` and the event type is `kEventProcessCommand`, `GetEventParameter` is called to extract the specified data from the event. This data is returned in a variable of type `HICCommand`.



If an examination of the `commandID` field of the `HICCommand` structure reveals that the command ID is 'quit', the handler returns `eventNotHandledErr`, ensuring that the event will be propagated to the standard application event handler. This ensures that the standard handler calls the default Quit Application Apple event handler.

The menu ID and item number are then extracted from the `HICCommand` structure. If the command ID is not 'quit' and the menu ID is that for one of the program's pull-down menus, `doMenuChoice` is called to further handle the event. Because the event is fully handled by the program, `noErr` is returned by the handler to ensure that the event is not further propagated.

In this program, each pop-up menu button control is handled in a different manner. As will be seen, the second (Country) pop-up menu button control is assigned the command ID 'ctry' (`kPopupCountryID`) on creation. Thus, if a mouse-down occurs in this pop-up menu button, the standard window event handler calls `TrackControl` to handle user action, following which the `kEventProcessCommand` is dispatched to the application. Within the application's application event handler, if the command ID in the `HICCommand` structure's `commandID` field is 'ctry', the function `doControlHit2` is called, following which `noErr` is returned by the handler.

If the event class is `kEventClassMenu` and the event type is `kEventMenuEnableItems`, the function `doAdjustMenus` is called. The `kEventMenuEnableItems` event type is dispatched when a mouse-down occurs in a pull-down menu or a menu-related Command-key equivalent is pressed.

If the event class is `kEventClassMouse` and the event type is `kEventMouseMoved`, and if the front window is of the document kind, the function `doAdjustCursor` is called to adjust the cursor to the I-beam shape if it is over an edit text control with keyboard focus, or to the arrow shape if it is not.

## **windowEventHandler**

`windowEventHandler` is the application's window event handler. It is a callback function.

The calls to `GetEventClass` and `GetEventKind` get the event class and type. The function then switches on the event class.

If the event class is `kEventClassWindow`, `GetEventParameter` is called to extract the window reference from the event before a switch on the event type is entered.

If the event type is `kEventWindowDrawContent`, the function `doDrawContent` (the window update function) is called. (Note that `doDrawContent` does not call `BeginUpdate` and `EndUpdate` because there is no need to call those functions when responding to `kEventWindowDrawContent` events.) The handler returns `eventNotHandledErr`, allowing the event to be passed to the standard window event handler which, in turn, attends to its part of the update process, including drawing the controls.

Note that registering the `kEventWindowDrawContent` event type and responding in this way obviates the necessity for an event filter (callback) function (which calls the window update function) for the movable modal dialog.

If the event type is `kEventWindowActivated` or `kEventWindowDeactivated`, the function `doActivateDeactivate` is called to draw the text in the window header in the appropriate (activated or deactivated) state. The handler returns `eventNotHandledErr`, allowing the event to be passed to the standard window event handler which, in turn, attends to its part of the activation/deactivation process, including activating/deactivating the controls.

If the event type is `kEventWindowGetIdealSize`, the handler responds by calling `SetEventParameter`, which sets the height and width to which the window will be zoomed when it is zoomed out. The handler returns `noErr` to defeat further propagation of the event.

If the event type is `kEventWindowGetMinimumSize`, the handler responds by calling `SetEventParameter`, which sets the minimum height and width to which the window can be resized. The handler returns `noErr` to defeat further propagation of the event.

If the event type is `kEventWindowZoomed`, the window's port rectangle is erased, the function `doAdjustScrollBars` is called to resize and reposition the scroll bars, and the handler returns `noErr`.

Since the `kWindowLiveResizeAttribute` attribute is set on the window, the `kEventWindowBoundsChanged` event type will be received continually as the window is being resized (as opposed to only one `kEventWindowBoundsChanged` event type being received, when the mouse button is released, when the `kWindowLiveResizeAttribute` attribute is not set). The function `doAdjustScrollBars` is continually called to resize and reposition the scroll bars, the function `doDrawMessage` is continually called to redraw the window header and associated text, and the handler returns `noErr`.

If the event type is `kEventWindowClose`, the function `doCloseWindow` is called to dispose of the window's controls and document structure handle, decrement the global variable holding the current number of open windows, and disable the Typing Target and Window menus if no windows will be open when this window is closed. `EventNotHandledErr` is returned by the handler to cause the standard window event handler to dispose of the window.

If the event class is `kEventClassControl` and the event type is `kEventControlClick`, `GetEventParameter` is called to extract the mouse location, which will be in global coordinates, from the event. The mouse coordinates are then converted to local coordinates preparatory to a call to `FindControlUnderMouse`. If there is a control under the mouse cursor, the function `doControlHit1` is called to further handle the event. When `doControlHit1` returns, the handler returns `noErr` to defeat further propagation of the event. (Note that, so far as the first (Time Zone) pop-up menu button is concerned, this approach to pop-up menu button control handling differs from that in the demonstration program `CarbonEvents1`.)

If the event class is `kEventClassKeyboard` and the event type is `kEventRawKeyDown`, and if the current typing target (as chosen in the Typing Target menu) is either the “document” or the “document” and edit text control combined, `GetEventParameter` is called twice to get the character code and the modifier keys that were down (if any), and both of these parameters are passed to the function `doDrawDocumentTyping` to draw the character and highlight the modifier key (if any) indicator in the (“document”) Typing group box in the window. If the current typing target is the “document” only, the handler returns `noErr` to prevent the edit text control receiving the event, otherwise `eventNotHandledErr` is returned to allow the event to propagate to the edit text control.

The last block pertains to the window-modal (sheet) alert created by the function `doSheetAlert` in `Dialogs.c`. When the user clicks in one of the sheet’s buttons, the parent window receives the relevant command ID (`kHICommandOK`, `kHICommandCancel`, or `kHICommandOther`). The identity of the button is drawn in the parent window’s window header frame.

### **doNewWindow**

After `GetNewCWindow` creates the window, `ChangeWindowAttributes` is called to cause the standard window event handler to be installed on the window.

The next block shows alternative window creation code for windows created programmatically using `CreateNewWindow`. Note that the standard window event handler will be installed because the `kWindowStandardHandlerAttribute` is included in the attributes passed in the second parameter of the `CreateNewWindow` call.

The call to `InstallWindowEventHandler` installs the application’s window event handler on the window. Since more than one window can be opened, the call to `InstallWindowEventHandler` will be called whenever a new window is opened. Accordingly, to prevent a possible memory leak, the call to `doGetHandlerUPP` (to get a UPP to the application’s window event handler) ensures that only one routine descriptor will be created regardless of how many windows are opened. (Recall from Chapter 5 that universal procedure pointer creation functions always allocate routine descriptors in memory on Mac OS 8/9, and sometimes allocate routine descriptors in memory on Mac OS X (depending on whether the application is compiled as a CFM binary or Mach-O binary).)

Note that registering the `kEventProcessCommand` event (class `kEventClassCommand`) is required in order to determine which button is clicked in a window-modal (sheet) alert.

### **doCloseWindow**

Note that `doCloseWindow` does not dispose of the window. As previously stated, the application’s window event handler allows `kEventWindowClose` events to be passed to the standard window event handler after `doCloseWindow` is called. The standard window handler disposes of the window.

### **doGetControls**

After the controls have been created, `SetControlCommandID` is called to assign the command ID 'ctry' (`kPopupCountryID`) to the second (Country) pop-up menu button control. As previously stated, this will cause a `kEventProcessCommand` event to be dispatched to the application when a mouse-down occurs in this pop-up menu button, allowing the application's application event handler to handle the event.

### **doIdle**

`doIdle` is called when the event timer fires. `IdleControls` is called to cause the insertion point caret to blink in the edit text control. (This call is not necessary on Mac OS X because Mac OS X controls have built-in timers.)

### **doDrawContent**

`doDrawContent` is the window update function, which is called when the `kEventWindowDrawContent` event type is received. As previously stated, there is no need to call `BeginUpdate` or `EndUpdate` in this function (though there would be, for Mac OS 8/9 only, if the `kEventWindowUpdate` event type had been registered rather than the `kEventWindowDrawContent` event type).

### **doControlHit1**

`doControlHit1` is called from the application's window event handler when the `kEventMouseDown` event type is received and a call to `FindControlUnderMouse` determines that there is a control under the mouse. Further processing of mouse-downs in the controls in this program is identical to that used in the demonstration program `Controls1` (see Chapter 7).

Note the differences in this program's approach to detecting and handling mouse-downs in a pop-up menu button control, as compared with the approach used in the demonstration program `CarbonEvents1`.

### **doControlHit2**

`DoControlHit2` is called from the application's application event handler when the `kEventProcessCommand` event type is received and the `commandID` field of the `HCommand` structure contains the second (Country) pop-up menu button control's command ID. The control's value is determined, allowing the chosen menu item's text to be extracted and drawn in the window header.

## **Dialogs.c**

### **doSheetAlert**

The call to `GetStandardAlertDefaultParams` initializes a standard `CFString` alert parameter structure with default values. (The defaults are: no Help button; no Cancel button; no Other button.) The next two lines cause a Cancel and Other button to be included.

The next block gets the message and informative strings to be passed in the call to `CreateStandardSheet`, which creates the sheet. The call to `ShowSheetWindow` displays the sheet.

Clicks in the sheet's buttons are handled in the parent window's handler (`windowEventHandler`).

### **doSheetDialog**

The call to `GetNewDialog` creates the dialog, whose window definition ID is `kWindowSheetProc` (1088). `GetDialogWindow` gets a reference to the dialog's window object, allowing `ChangeWindowAttributes` to be called to cause the standard window event handler to be installed on the window.

The call to `InstallWindowEventHandler` installs the handler `sheetEventHandler` on the dialog. Note that the function `doGetSheetHandlerUPP` is called to get the universal procedure pointer to the handler passed in the second parameter of the `InstallWindowEventHandler` call.

`SetDialogDefaultItem` establishes the single push button item in the dialog as the default button. The next block sets some initial text in the dialog's edit text item and selects that text.

The call to `ShowSheetWindow` displays the sheet.

### **doGetSheetHandlerUPP**

`doGetSheetHandler` serves the same purpose for window-modal (sheet) dialogs as does `doGetHandlerUPP` (see above) for document windows.

### **sheetEventHandler**

`sheetEventHandler` is the event handler for window-modal (sheet) dialogs. It is a callback function.

If the `kEventMouseDown` event type is received, `GetEventParameter` is called to get the mouse location, which is then converted to the local coordinates required by `FindControlUnderMouse`. If the call to `FindControlUnderMouse` reveals that there is a control under the mouse, `GetDialogFromWindow` is called to get a reference to the dialog, allowing `GetDialogItemAsControl` to get a reference to the first item in the dialog's item list (the OK push button).

If the control clicked is the OK push button, the current text in the edit text item is extracted for display in the parent window's window header frame, `HideSheetWindow` is called to hide the sheet and `DisposeDialog` disposes of the sheet and releases all related memory.

If the mouse click was in the edit text item, `eventNotHandledErr` is returned so that the event can be handled by the standard handler.



## doMovableModalDialog

`doMovableModalDialog` creates a movable modal dialog containing three checkbox controls, a group box control, and an OK push button control.

`CreateNewWindow` creates an initially invisible window of class `kMovableModalWindowClass` with the standard window handler installed. The `RepositionWindow` call ensures that the dialog will appear in the alert position on the main screen. `SetThemeWindowBackground` sets the dialog's background color/pattern to the correct color pattern for dialogs.

`CreateRootControl` creates a root control for the window, ensuring that activation/deactivation of the controls will be automatic.

The next three blocks create the dialog's controls. In the case of the OK push button and checkbox controls, a control ID is assigned to each control. The initial value of the checkbox controls is set to 0.

`InstallWindowEventHandler` installs the event handler `dialogEventHandler` on the window. With the dialog fully prepared, `ShowWindow` displays the dialog.

`RunAppModalLoopForWindow` is the Carbon event model equivalent of the Classic event model's `ModalDialog`. It will exit when `QuitAppModalLoopForWindow` is called in the dialog's event handler. Although it will block until the modal loop ends, your application's other handlers will still be called.

`RunAppModalLoopForWindow` attends to the menu deactivation usually associated with the display of a movable modal dialog.

## dialogEventHandler

`dialogEventHandler` is the event handler for the movable modal dialog. It is a callback function.

If the `kEventControlHit` event type is received, `GetEventParameter` is called to get a reference to the control, allowing the call to `GetControlID` to get the control's ID.

If the control is the OK push button, the `QuitAppModalLoopForWindow` call terminates the modal loop and restores menu activation/deactivation status to that which obtained prior to the call to `RunAppModalLoopForWindow`.

If the control is one of the checkbox controls, the current value of the control is flipped and the new value is assigned to the relevant global variable which keeps track of the control values between successive invocations of the dialog.



# Files and Navigation Services

## CHAPTER

# 18

## IN THIS CHAPTER

- Introduction 948
- Files 948
- Navigation Services 964
- Main File Manager Constants, Data Types and Functions 980
- Relevant Resource Manager Functions 982
- Relevant Finder Interface Functions 982
- Main Navigation Services Constants, Data Types, and Functions 983
- Demonstration Program Files Listing 987
- Demonstration Program Files Comments 1029



## Introduction

This chapter addresses

- Creating, opening, reading from, writing to, and closing files.
- Navigation Services, an application programming interface that allows your application to provide a user interface for navigating, opening, and saving Mac OS file objects.

## Files

### Types of Files

A file is a named, ordered sequence of bytes stored on a volume. The files associated with an application are typically:

- The application file itself, which comprises the application's executable code and any application-specific resources and data.
- Document files created by the user, which the user can edit.
- A preferences file created by the application to store user-specified preference settings for the application.

The operating system also uses files for certain purposes. For example, as stated in Chapter 9, the File Manager uses a special file called the volume's **catalog file** to maintain the hierarchical organization of files and folders in a volume.

## Characteristics of Files

### File Forks

Macintosh files comprise two **forks**, called the **data fork** and the **resource fork**. The resource fork contains a resource map and resources. Unlike the bytes stored in the resource fork, the bytes in the data fork do not require any particular internal structure. Your application must therefore be able to interpret the bytes in the data fork in an appropriate manner.

All Macintosh files contain a data fork and a resource fork; however, one or both of these forks may be empty. Fig 1 shows the typical contents of the data and resource forks of an application file and a document file.

If your data can be structured as a resource, you might elect to store that data in the resource fork, in which case you use Resource Manager functions to both store and retrieve it. Retrieving data from a resource fork is a comparatively simple matter because all you have to do is pass the resource type and ID to the relevant Resource Manager function.

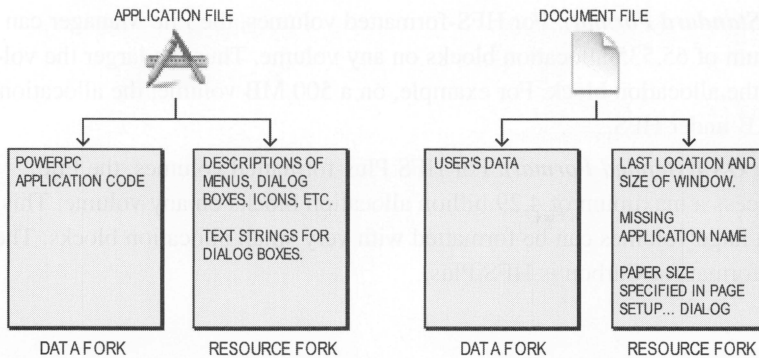


FIG 1 - TYPICAL CONTENTS OF DATA FORKS AND RESOURCE FORKS IN APPLICATION AND DOCUMENT FILES

If it is neither possible nor advisable to store the data in the resource fork; you must store it in the data fork. This is normally the favored option for storing a document's text, for example. In this case, you use File Manager functions to store and retrieve the data. With File Manager functions, unlike Resource Manager functions, you can access any byte, or group of bytes, individually.

Generally speaking, unless the data created by the user will occupy only a small number of resources, you should store it in the data fork. The Resource Manager was not designed as a general purpose data storage and retrieval system.

## File Size

### Volumes

A **volume**, which can be an entire disk or only part thereof, is that part of a storage device formatted to contain files. Ordinarily, file size is limited only by the size of the volume that contains it.

### Logical Blocks and Allocation Blocks

Volumes are formatted into **logical blocks**. Each logical block can contain up to 512 bytes, the actual size being of interest only to the disk device driver. When the File Manager allocates space for a file, it allocates it in units called **allocation blocks**, which are groups of consecutive logical blocks. A non-empty file fork always occupies at least one allocation block.

The size of an allocation block is the chief distinguishing feature between the volume format known as the Hierarchical File System (HFS) and the newer Hierarchical File System Plus (HFS Plus or HFS+) introduced with Mac OS 8.1. The differences are as follows:

- **HFS (Mac OS Standard Format).** For HFS-formatted volumes, the File Manager can access a maximum of 65,535 allocation blocks on any volume. Thus the larger the volume, the larger the allocation block. For example, on a 500 MB volume, the allocation block size is 8KB under HFS.
- **HFS Plus (Mac OS Extended Format).** For HFS Plus-formatted volumes, the File Manager can access a maximum of 4.29 billion allocation blocks on any volume. This means that even huge volumes can be formatted with very small allocation blocks. The default volume format for Carbon is HFS Plus.

#### NOTE

Beginning with Mac OS 9, HFS Plus introduced support for long Unicode filenames, files larger than 2GB, and extended file attributes. The additional File Manager constants, data types, and functions introduced at that time are often referred to as the HFS Plus API.

On large volumes, the significant reduction in allocation block size under HFS Plus results in significant space savings. For example, on a 4 GB volume, a file containing only 4 KB of information requires 64 KB of space under HFS, whereas the same file requires only 4KB of space under HFS Plus.

### Physical and Logical End-Of-File

There is a difference between the amount of space allocated to a file and the number of bytes of actual data in the file. This is reflected in the two numbers used to describe the size of a file:

- **Physical End-Of-File.** The physical end-of-file is the number of bytes currently allocated to the file by the File Manager. Since the file's first byte is byte number 0, the physical end-of-file is 1 greater than the number of the last byte in its last allocation block. The physical end-of-file is thus always an exact multiple of allocation block size.
- **Logical End-Of-File.** The logical end-of-file is one greater than the number of bytes that currently contain data.

Fig 2 illustrates logical end-of-file and physical end-of-file.

Your application can adjust the size of a file by moving the logical end-of-file. If, when you increase the size of a file, the logical end-of-file is moved past the physical end-of-file, one or more allocation blocks are automatically added to the file by the File Manager. By the same token, the File Manager automatically deletes the unneeded allocation block if you move the logical end-of-file more than one allocation block short of the current physical end-of-file.

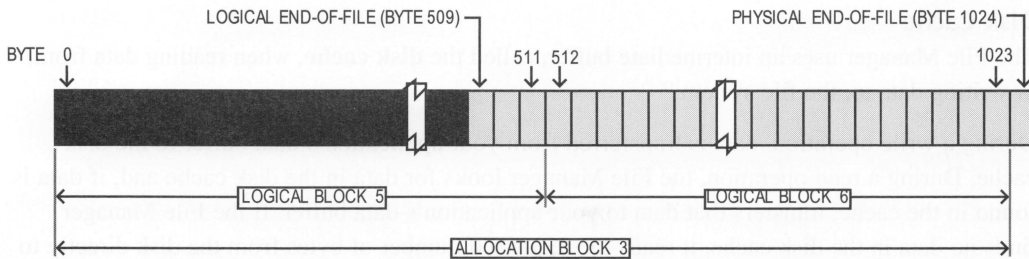


FIG 2 - LOGICAL AND PHYSICAL END-OF-FILE

### Clumps and Combating File Fragmentation

The volume's **clump** size determines the number of allocation blocks added to the file when you move the logical end-of-file past the physical end-of-file. The File Manager enlarges files by adding clumps (which are groups of *contiguous* allocation blocks) as a way of reducing file fragmentation and improving input/output performance.

Your application can also take steps to reduce file fragmentation. Suppose you are extending a file with multiple write operations. If you know before you begin how large the file is likely to become, you should first call `SetEOF` to set the file to that size.

### File Access

The operations your application can perform on a file depend on whether it is open or closed. For example, reading and writing operations can only be performed on open files, and deleting operations can only be performed on closed files.

### Access Path and File Reference Number

When a file is opened, the File Manager reads in file information and creates an **access path** to the file. The file information is stored in a **file control block** (FCB). The access path, which is assigned a unique **file reference number**, specifies the volume on which the file is located and the location of the file on that volume.

### File Mark

The File Manager maintains a **file mark** (a current-position marker) for each access path. The file mark, which is moved each time a byte is read or written, is the number of the next byte to be read or written. By setting the file mark or specifying an offset, you can control the beginning point of a read or write operation.

### Data Buffer

When it transfers data to or from your application, the File Manager uses a **data buffer** in RAM. You must therefore pass the address of this data buffer whenever you read or write a file's data.

### Disk Cache

The File Manager uses an intermediate buffer, called the **disk cache**, when reading data from, or writing data to, the file system.

During a write operation, data is transferred from your application's data buffer to the disk cache. During a read operation, the File Manager looks for data in the disk cache and, if data is found in the cache, transfers that data to your application's data buffer. If the File Manager finds no data in the disk cache, it reads the requested number of bytes from the disk directly to your application's data buffer.

## The Hierarchical File System

### Directories and Directory ID

The method used to organize files on a Macintosh volume is called a **hierarchical file system**. In this system, files are grouped into **directories** (also called **folders**). These directories may, in turn, be grouped into other directories (see Fig 3). As shown in Fig 3, each directory has a number associated with it called the **directory ID**.

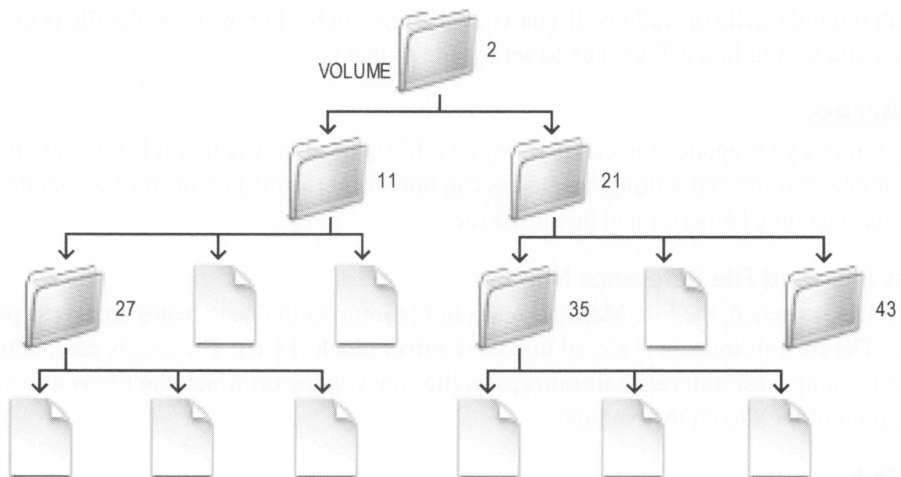


FIG 3 - MACINTOSH HIERARCHICAL FILE SYSTEM

### Root Directory

The Finder and the File Manager work together to maintain the organization of files and folders on a volume, ensuring that the representation on the desktop corresponds directly to the hierarchical directory structure on the volume. In file system parlance, the volume is referred to as the **root directory**, and the folders are referred to as **subdirectories** (or simply as **directories**).

## Mounted Volumes

When a volume is **mounted**, the File Manager places information about the volume in a **volume control block (VCB)** and assigns a **volume reference number** by which you can refer to the volume until it is **unmounted**. Mounted volumes appear on the desktop.

You can identify a volume by its volume reference number or by its **volume name**. To avoid confusion between volumes with the same name, you should ordinarily use the volume reference number to refer to a volume.

When a volume is unmounted, the volume control block is released and the volume is no longer known to the File Manager.

## Parent Directory and Parent Directory ID

The directory in which a subdirectory is located is referred to as a **parent directory**. A parent directory is assigned a **parent directory ID**. A special parent directory ID is assigned by the File Manager to a volume's root directory. All this facilitates a consistent method of identifying files and directories using the volume reference number, the parent directory ID, and the file or directory name.

Generally speaking, your application does not need to keep track of the location of files in the file system hierarchy. The location of most of the files your application opens and saves is provided by either the Finder or Navigation Services.

## Aliases

An **alias** is a special kind of file that represents another file, folder, or volume. The Finder and Navigation Services automatically resolve aliases.

## Identifying Files and Directories—File System Specification Structure and File System Reference

Three pieces of information are all that is needed to identify a file or directory: a volume reference number; a parent directory ID; the name of the file or directory. Of relevance in this regard are two data types, namely, the **file system specification structure** and the opaque **file system reference**:

```
struct FSSpec
{
    short vRefNum; // Volume reference number.
    long parID;    // Directory ID of parent directory.
    Str63 name;    // Filename or directory name.
};
typedef struct FSSpec FSSpec;
typedef FSSpec *FSSpecPtr, **FSSpecHandle;

struct FSRef
```



```

{
    UInt8 hidden[80];
};
typedef struct FSRef FSRef;
typedef FSRef *FSRefPtr;

```

The opaque data type `FSRef`, whose purpose is similar to that of the file system specification structure, was introduced with the HFS Plus API. Note that there is no need to call the File Manager to dispose of an `FSRef` when it is no longer needed.

## Creating, Opening, Reading From, Writing To, and Closing Files

Your application typically creates, opens, reads from, writes to, and closes files in response to the user choosing commands from the File menu. In addition, your application opens, reads from, writes to, and closes files in response to the required Apple events (see Chapter 10).

The following describes how to perform typical file operations within the context of a user choosing commands from an imaginary application's File menu and, on Mac OS X, the Quit command. For the purposes of illustration, the assumption is made that the files involved store text documents and that, when retrieved from file, the documents are displayed in a window with scroll bars.

### General File Menu and Required Apple Events Handling Strategy

A suggested general strategy for handling user choices of the New, Open, Close, Save, Save As, Revert, and Quit commands, and for responding to the required Apple events, is illustrated in Fig 4.

### Preliminaries—Creating a Document Structure

The contents of document files are displayed in windows. Ordinarily, your application should define a **document structure** that contains information about the window and information about the file whose contents are displayed in the window. The following is an example of a document structure for an application that handles text files:

```

typedef struct
{
    ControlHandle vScrollBarHdl; // Handle to vertical scroll bar.
    ControlHandle hScrollBarHdl; // Handle to horizontal scroll bar.
    SInt16         fileRefNum;    // File reference number for window's file.
    FSSpec         fileFSSpec;    // File's file system specification structure.
    TEHandle       textEditHdl;   // Handle to TextEdit structure.
    Boolean        windowTouched; // Has window's data changed?
} documentStructure;

typedef documentStructure *documentStructurePtr;
typedef documentStructure **documentStructureHdl;

```

Note the `fileRefNum` and `fileFSSpec` fields. Note also that the last field (`windowTouched`) is used to record whether the content of the document in memory differs from that in the associated file. Your application should set this field to `false` when it first reads in the file and immediately after each save, and to `true` when the content of the document in memory is changed by the user after the first read-in and after the subsequent saves. If the `windowTouched` field is set to `true` and the user attempts to close the document window, your application should present an alert asking the user whether the changed version of the document should be saved.

Document structures can be associated with the relevant window by storing a handle to the structure in the window object using the function `SetWRefCon`.

## Creating a New Document Window

The user creates a new untitled document window using the New command in the File menu. In addition, it is usual for an application to open a new untitled document window when it receives an Open Application Apple event from the Finder. (See `doNewCommand` in Fig 4.)

Although the function that responds to the user choosing the New command and Open Application Apple event opens a new window, it should not create a new file. The reason for this is that, in the event, the user may elect not to save the document. It is thus preferable to wait until the user decides to save the new document before creating a file. Accordingly, the `fileRefNum` field of the new window's document structure should be set to 0 to indicate that no file is currently associated with this window.

## Opening a File and Reading in Data

Your application will need to open a file when the user chooses the Open command from the File menu (see `doOpenCommand` in Fig 4) and when it receives Open Documents and (on Mac OS 8/9) Print Documents Apple events.

### Opening the Navigation Services Open Dialog

Your application's initial response to the user choosing the Open command from the File menu should be to elicit a file selection from the user by creating and displaying a Navigation Services Open dialog (see Fig 6).

Calls to the Navigation Services 3.0 functions `NavCreateGetFileDialog` and `NavDialogRun` create and display the Navigation Services Open dialog. When the user addresses the dialog, selects one or more files, and clicks the Open button, your application examines the `selection` field of a `NavReplyRecord` structure (see Navigation Services, later in this chapter) and disposes of the dialog. The `selection` field is an Apple Event descriptor list (`AEDescList`). You can determine the number of files in the list by calling the Apple Event Manager function `AECntItems`. Each selected file object is described in an `AEDesc` structure. You can coerce this descriptor into a file system specification (`FSSpec`) structure to perform operations such as opening the file.



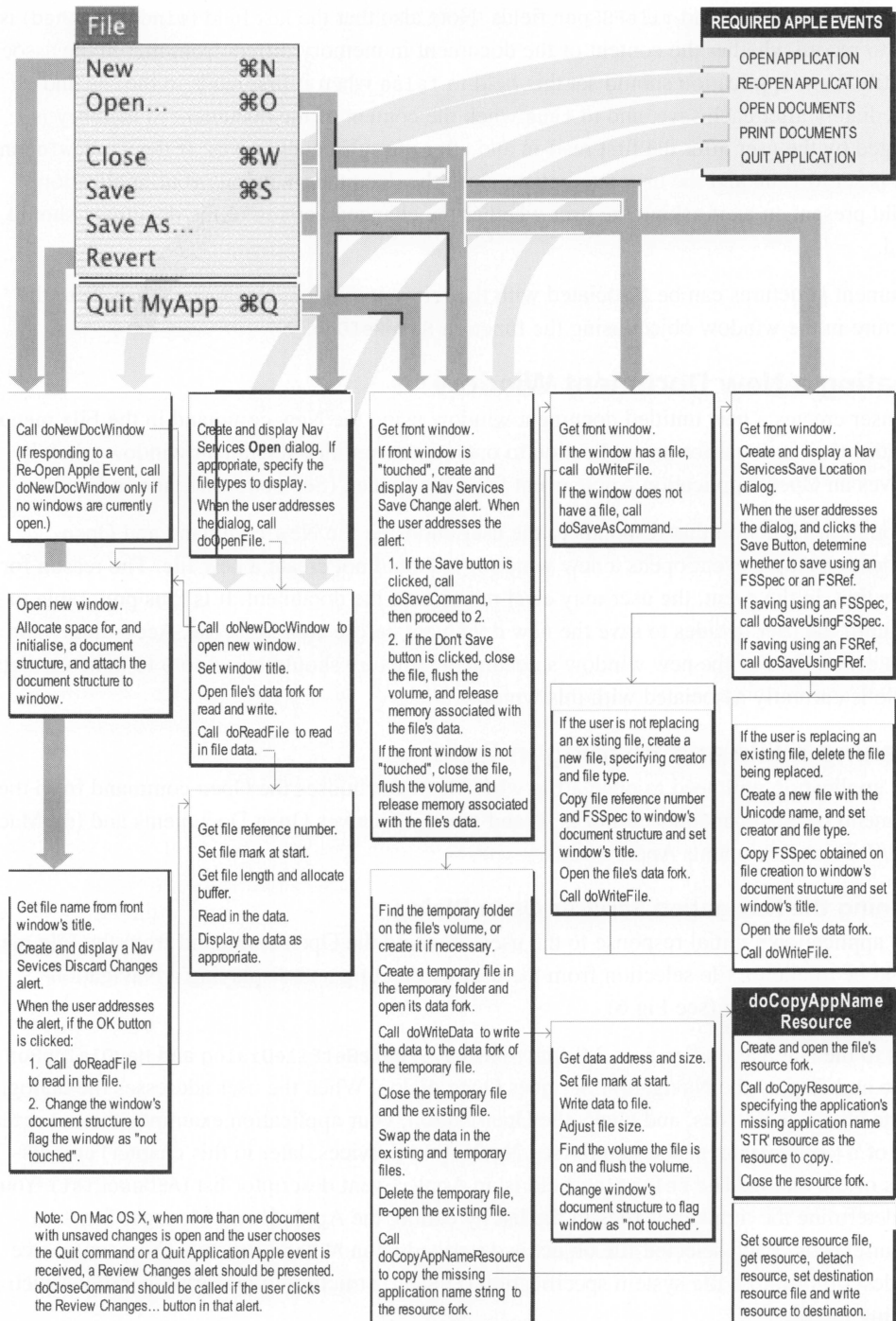


FIG 4 - GENERAL FILE MENU, QUIT ITEM, AND REQUIRED APPLE EVENTS HANDLING STRATEGY

## Creating a Window and Opening the File

The next steps are to call a function (`doNewDocWindow` in Fig 4) to create a window and associated document structure and open the selected file's data fork (`doOpenFile` in Fig 4).

The file's data fork is opened using `FSpOpenDF`:

```
OSErr FSpOpenDF(spec, permission, refNum);
FSSpec *spec;      File system specification structure.
SInt8 permission;  Access mode.
short *refNum;      Returned file reference number.
```

`FSpOpenDF` takes the `FSSpec` returned by Navigation Services as its first parameter. The `permission` field specifies the **access mode** for opening the file. The access mode may be specified using one of the following constants:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>fsCurPerm</code>	0	Whatever permission is allowed.
<code>fsRdPerm</code>	1	Read permission.
<code>fsWrPerm</code>	2	Write permission.
<code>fsRdWrPerm</code>	3	Exclusive read/write permission.
<code>fsRdWrShPerm</code>	4	Shared read/write permission.

`FSpOpenDF` returns, in its third parameter, a file reference number. This reference number should be saved to the window's document structure so that it can be readily retrieved for use as a parameter in calls to functions that read from and write to the file.

## Reading File Data

When you have opened a file, you can read data from it. Ordinarily, you will want to read data from the file when the user first opens it. And your application will have to read data from the file when the user chooses the Revert command in the File menu to revert to the last saved version of the document (see `doRevertCommand` in Fig 4). Typically, a function for reading file data

- Retrieves the file reference number from the document structure.
- Calls `SetFPos` to set the file mark to the beginning of the file:

```
OSErr SetFPos(refNum, posMode, posOff);
short refNum;  File reference number.
short posMode; Positioning mode.
long posOff;   Positioning offset.
```

The `posMode` parameter must contain one of the following constants:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>fsAtMark</code>	0	Remain at current mark.
<code>fsFromStart</code>	1	Set mark relative to beginning of file.
<code>fsFromLEOF</code>	2	Set mark relative to logical end of file.
<code>fsFromMark</code>	3	Set mark relative to current mark.
<code>rdVerify</code>	64	Add to above for read-verify.

- Determines the number of bytes in the file by calling `GetEOF`:

```
OSErr GetEOF(refNum, logEOF);
short refNum;    File reference number.
long *logEOF;    Receives length of file, in bytes.
```

- Calls `FSRead` to read the specified number of bytes from the file into the specified buffer:

```
OSErr FSRead(refNum, count, buffPtr);
short refNum;    File reference number.
long *count;     On input: bytes to read. On output: actual bytes read.
void *buffPtr;   Address of buffer into which bytes are to be read.
```

Note that `FSRead` returns, in the `count` parameter, the actual number of bytes read.

## Saving a File

The user can indicate that the current contents of a document should be saved:

- By choosing `Save` or `Save As` from the `File` menu.
- By clicking the `Save` button in the `Navigation Services Save Changes` alert when the user attempts to close a “touched” window.
- By clicking the `Save` button in the `Navigation Services Save Changes` alert when the user attempts to quit the application while a “touched” window remains open.

## Handling the Save Command

To handle the `Save` command (see `doSaveCommand` in Fig 4), your application should

- Check the file reference number field of the window’s document structure to determine if the window already has a file.
- If the window already has a file, call the function for writing files to disk (see `doWriteFile` in Fig 4). If the window does not have a file, call the function for handling the `Save As` command.

## Handling the Save As Command

To handle the `Save As...` command (see `doSaveAsCommand` in Fig 4), your application should proceed as follows

- Call the Navigation Services 3.0 functions `NavCreatePutFileDialog` and `NavDialogRun` to create and display the Navigation Services Save Location dialog (see Fig 10).

When the user addresses the dialog and clicks the Save button, your application examines the selection field of a `NavReplyRecord` structure (see Navigation Services, below) and disposes of the dialog. The selection field is an Apple Event descriptor list (`AEDescList`). The file object is described in an `AEDesc` structure. If your application is running on Mac OS X, you will be able to coerce this data to type `FSRef`. If this coercion fails (meaning that your application is running on Mac OS 8/9) you will be able to coerce the data to type `FSSpec`. The `FSRef` or `FSSpec` will be required for the save operation.

- **Save Using *FSRef*.** If the coercion to type `FSRef` succeeds
  - Call `AEGetDescData` to extract the data from the `dataHandle` field of the `AEDesc` structure. This is the `FSRef` for the parent directory.
  - Call `CFStringGetCharacters` to extract into a buffer the contents of the string referenced in the `saveFileName` field of the `NavReplyRecord` structure.
  - If the replacing field of the `NavReplyRecord` structure contains `true`, call the HFS Plus API function `FSMakeFSRefUnicode` to create an `FSRef` for the file, passing in the `FSRef` for the parent directory and the extracted filename characters. Pass this `FSRef` in a call to `FSDeleteObject` to delete the file:

```
OSErr  FSDeleteObject(ref);
const FSRef *ref;  Pointer to FSRef specifying file or directory to delete.
```

- Call `FSCreateFileUnicode`, passing in the `FSRef` for the parent directory and the extracted filename characters, to create a new file with a Unicode name:

```
OSErr  FSCreateFileUnicode(parentRef, nameLength, name, whichInfo, catalogInfo,
                           newRef, newSpec);

const FSRef      *parentRef;    FSRef for directory where file to be created.
UniCharCount     nameLength;    Length of file's name.
const UniChar    *name;        Unicode name for file.
FSCatalogInfoBitmap whichInfo;  Catalog information fields to be set, if any.
const FSCatalogInfo *catalogInfo; Values of file's catalog infoformation.
FSRef            *newRef;       On return, FSRef for new file.
FSSpec           *newSpec;      On return, FSSpec for new file.
```

- Call `FSGetFInfo`, passing in the `FSSpec` received in the last parameter of the call to `FSCreateFileUnicode`. Assign the file type and creator to the relevant fields of the obtained `FInfo` structure and call `FSSetFInfo` to set the Finder information.
- Assign the file system specification (`FSSpec`) structure to the file system specification structure field of the window's document structure.
- Call `FSOpenDF` to open the data fork.
- Assign the file reference number returned by `FSOpenDF` to the file reference number field of the window's document structure.

- Call `SetWTitle` to set the window's title, using the string extracted from the name field of the file system specification (`FSSpec`) structure.
- Call the function for writing files to disk (see `doWriteFile` in Fig 4).
- **Save Using *FSSpec*.** If the coercion to type `FSRef` does not succeed
  - Call the Navigation Services 3.0 function `NavDialogGetSaveFileName` to get the file name from the edit text field of the Save Location dialog, convert it to a Pascal string using `CFStringGetPascalString`, and assign that string to the name field of the file system specification (`FSSpec`) structure.
  - If the replacing field of a `NavReplyRecord` structure does not contain `true`, call `FSPCreate` to create a new file and set the file type and creator:
 

```
OSErr  FSPCreate(spec,creator,fileType,scriptTag);
FSSpec  *spec;      File system specification structure.
OSType  creator;    File creator.
OSType  fileType;   File type.
ScriptCode scriptTag; Code of script system in which filename is displayed.
```
  - Assign the coerced file system specification (`FSSpec`) structure to the file system specification structure field of the window's document structure.
  - If the window already has a file (that is, if the file reference number field of the document structure does not contain 0), close that file with a call to `FSClose`

```
OSErr  FSClose(refNum);
short  refNum;  File reference number.
```
  - Call `FSpOpenDF` to open the data fork.
  - Assign the file reference number returned by `FSpOpenDF` to the file reference number field of the window's document structure.
  - Call `SetWTitle` to set the window's title, using the string extracted from the name field of the file system specification (`FSSpec`) structure.
  - Call the function for writing files to disk (see `doWriteFile` in Fig 4).

## Writing File Data

The function for writing data (see `doWriteFile` in Fig 4) should write to a temporary file, not to the document file. If you write directly to the document's file, you risk corrupting that file if the write operation does not complete successfully. For saving data *safely* to disk, write the data to a temporary file and then, assuming the temporary file has been written successfully, swap the contents of the temporary file and the document's file.

The procedure for updating a file safely is as follows:

- Get the file system specification from the document structure.
- Create a temporary filename for the temporary file.
- Call `FindFolder` to find the temporary folder on the file's volume, or create it if necessary:

```
OSErr  FindFolder(vRefNum,folderType,createFolder,foundVRefNum,foundDirID);
short  vRefNum;      Volume reference number.
```

```

OSType  folderType;    Folder type for volume.
Boolean createFolder;   kCreateFolder or kDontCreateFolder.
short   *foundVRefNum;  Volume reference number for folder found.
long    *foundDirID;    Directory ID of folder found.

```

- Call `FSMakeFSSpec` to make a file system specification structure for the temporary file:

```

OSErr  FSMakeFSSpec(vRefNum,dirID,fileName,spec);
short   vRefNum;    Volume reference number.
long    dirID;      Parent directory ID.
ConstStr255Param fileName; Full or partial pathname.
FSSpec   spec;      Pointer to FSSpec structure.

```

- Call `FSpCreate` to create the temporary file, and `FSpOpenDF` to open the temporary file's data fork.
- Call the function for writing data to a file (see `doWriteData` in Fig 4). This function should:

- Retrieve the address and length of the buffer (for example, from a `TextEdit` structure).

- Call `SetFPos` to set the file mark to the beginning of the file.

- Call `FSWrite` to write the buffer to the file

```

OSErr  FSWrite(refNum,count,bufferPtr);
short   refNum;    File reference number.
long    *count;    On input: bytes to write. On output: bytes written.
const void *bufferPtr; Address of buffer containing data to write.

```

- Call `SetEOF` to resize the file to the number of bytes actually written

```

OSErr  SetEOF(refNum,logEOF);
short refNum;    File reference number.
long  logEOF;    Logical end-of-file.

```

- Call `GetVRefNum` to determine the volume containing the file

```

OSErr  GetVRefNum(refNum,vRefNum);
short refNum;    File reference number.
short *vRefNum;  Receives volume reference number.

```

- Call `FlushVol` to flush the volume

```

OSErr  FlushVol(volName,vRefNum);
ConstStr63Param volName; Pointer to name of mounted volume
short   vRefNum;    Volume reference number.

```

Flushing the volume ensures that both the file's data and the file's catalog entry are updated.

## NOTE

The catalog entry for a file contains fields that describe the physical data (such as the first allocation block and the physical and logical ends of both the resource and data forks) and fields that describe the file within the file system, such as file ID and parent directory ID.



- Call `FSClose` to close the temporary file.
- Call `FSClose` to close the existing file.
- Call `FSpExchangeFiles` to swap the contents of the temporary file and the existing file

```
OSErr FSpExchangeFiles(source,dest);
const FSSpec *source;   Source file.
const FSSpec *dest;     Destination file.
```

`FSpExchangeFiles` does not actually move the data on the volume. It merely changes the information in the volume's catalog file and, if the files are open, their file control blocks (FCBs).

- Call `FSpDelete` to delete the temporary file
- Call `FSpOpenDF` to re-open the data fork of the existing file.

```
OSErr FSpDelete(spec);
const FSSpec *spec;   File system specification.
```

As a final step for Mac OS 8/9, you should call a function that copies the missing application name string resource (see Chapter 9) from the resource fork of the application file to the resource fork of the newly created file. This function (`doCopyAppNameResource` in Fig 4) should

- Call `FSpCreateResFile` to create the new file's resource fork

```
void FSpCreateResFile(spec,creator,fileType,scriptTag);
const FSSpec *spec;       File system specification structure.
OSType creator;           File creator.
OSType fileType;          File type.
ScriptCode scriptTag;     Code of script system.
```

- Call `FSpOpenResFile` to open the resource fork

```
short FSpOpenResFile(spec,permission);
const FSSpec *spec;       File system specification structure.
SignedByte permission;    Permission code.
```

The constants used to specify the access mode in the `FSpOpenDF` call (see above) are also used to specify the permission code in the `FSpOpenResFile` call.

- Call a function (`doCopyResource` in Fig 4), which copies specified resources from one resource file to another, to copy the missing-application name 'STR ' resource (ID - 16396) from your application's resource fork to the resource fork of the newly-created file.
- Call `FSClose` to close the resource fork.

## Reverting to a Saved File

To allow the user to revert to the last saved version of a document, your application can include a Revert command in the File menu. To handle this command (see `doRevertCommand` in Fig 4), you should call the Navigation Services 3.0 functions `NavCreateAskDiscardChangesDialog` and `NavDialogRun` to create and display a Navigation Services Discard Changes alert (see Fig

13). When the user addresses the dialog, and clicks on the OK button, you simply call your function for reading file data (`doReadFile` in Fig 4) to read the file back into the window.

## Closing a File

Your application should ordinarily close a file when the user clicks in the close box of the associated window or chooses the Close command from the File menu. You may also need to close files when the user chooses Quit from the File menu or a Quit Application Apple event is received from the Finder.

When your application needs to close a file, it should first (c)check whether the associated window has been “touched” (see `doCloseCommand` in Fig 4). If the window has been “touched,” you should call the Navigation Services 3.0 functions `NavCreateAskSaveChangesDialog` and `NavDialogRun` to create and display a Navigation Services Save Changes alert (see Fig 12). When the user addresses the dialog

- If the Save button is clicked, call the function for saving files (`doSaveCommand` in Fig 4), call `FSClose` to close the file, call `FlushVol` to ensure that both the file’s data and the file’s catalog entry are updated, set the file reference number field in the document structure to 0, and release memory associated with the storage of the file’s data. Then dispose of the document structure and, finally, the window.
- If the Don’t Save button is clicked, perform the same actions as are performed when the Save button is clicked except for the call to the function for saving files.

If the window has not been “touched,” perform the same actions as are performed when the Save button is clicked in a Save Changes alert except for the call to the function for saving files.

## File Synchronization Functions

It is possible that, while a document file is open, the user may drag its Finder icon or proxy icon to another folder (including the Trash) or change the name of the file via the Finder icon. The application has no way of knowing that this has happened and will assume, unless it is informed otherwise, that the document’s file is still at its original location with its original name. For this reason, applications often include a frequently called **file synchronization function** that synchronizes the application with the actual current location (and name) of its currently open document files.

In applications that use the Classic event model, file synchronization functions should be called after every call to `WaitNextEvent`. In applications that use the Carbon event model, a timer should be installed to trigger repeated calls to the file synchronization function. For each of the application’s document windows, the synchronization function should update the application’s internal data structures to match that of the document file as it exists on disk. The function should also ensure that, where necessary, the name of the document window is changed to match the current name of the document file on disk and close the document window if the document file has been moved to the Trash folder.



## Navigation Services

The user interface for opening and saving files, confirming saves and discarding changes, choosing a volume, folder, file, or file object, creating a new folder, file format translation, and easy navigation of the file system is provided by Navigation Services.

The following reflects Navigation Service 3.0, which was introduced with CarbonLib 1.1, and which established a new model for the creation, display, and handling of Navigation Services dialogs and alerts. Navigation Services 3.0 also introduced support for Unicode and, on Mac OS X, support for sheets and the ability to specify the modality of a dialog.

### Navigation Services Dialogs and Alerts

The primary dialogs created by Navigation Services are as follows:

- Open.
- Save Location.
- Choose a Volume.
- Choose a Folder.
- Choose a File.
- Choose a File Object.

The primary alerts created by Navigation Services are as follows:

- Save Changes
- Discard Changes.

A further alert, which is applicable only on Mac OS X, and for which no Navigation Services creation function existed at the time of the first release of Mac OS X, is the Review Changes alert.

The secondary dialogs and alerts created by Navigation Services are as follows:

- New Folder dialog.
- Replace Confirmation alert.
- Mac OS 8/9 Stationery option dialog.

## Modality

On Mac OS 8/9, all primary Navigation Services dialogs are movable modal provided an application-defined event handling (callback) function is provided.

On Mac OS X, your application should ensure that:

- The Save Location dialog, Save Changes alert, and Discard Changes alert are window-modal (that is, sheets).
- The other primary dialogs are application-modal.

## Standard User Interface Elements in Primary Dialogs

The standard user interface elements in Navigation Services primary dialogs are shown in Fig 5.

### Preview

On Mac OS 8/9, the user can toggle on and off a preview area using the Show/Hide Preview push button in the Open dialog. A preview of any file that contains a valid 'pnot' resource will be displayed in this area.

On Mac OS X, the preview appears in the column browser as shown in Fig 5. For files of type "TEXT" a preview is automatically created.

### Persistence

Navigation Services has the capability to store information, and to store it on a per-application basis. This ability is called **persistence**. For example, when a primary dialog is displayed, the browser defaults to the directory location that was in use when that particular dialog was last closed by that particular application. In addition, if a file or folder was selected when the dialog was last closed, that file or folder is automatically selected when the dialog is re-opened. For dialogs that are not sheets, the size, position, and, on Mac OS 8/9, sort key and sort order are also remembered for each application.

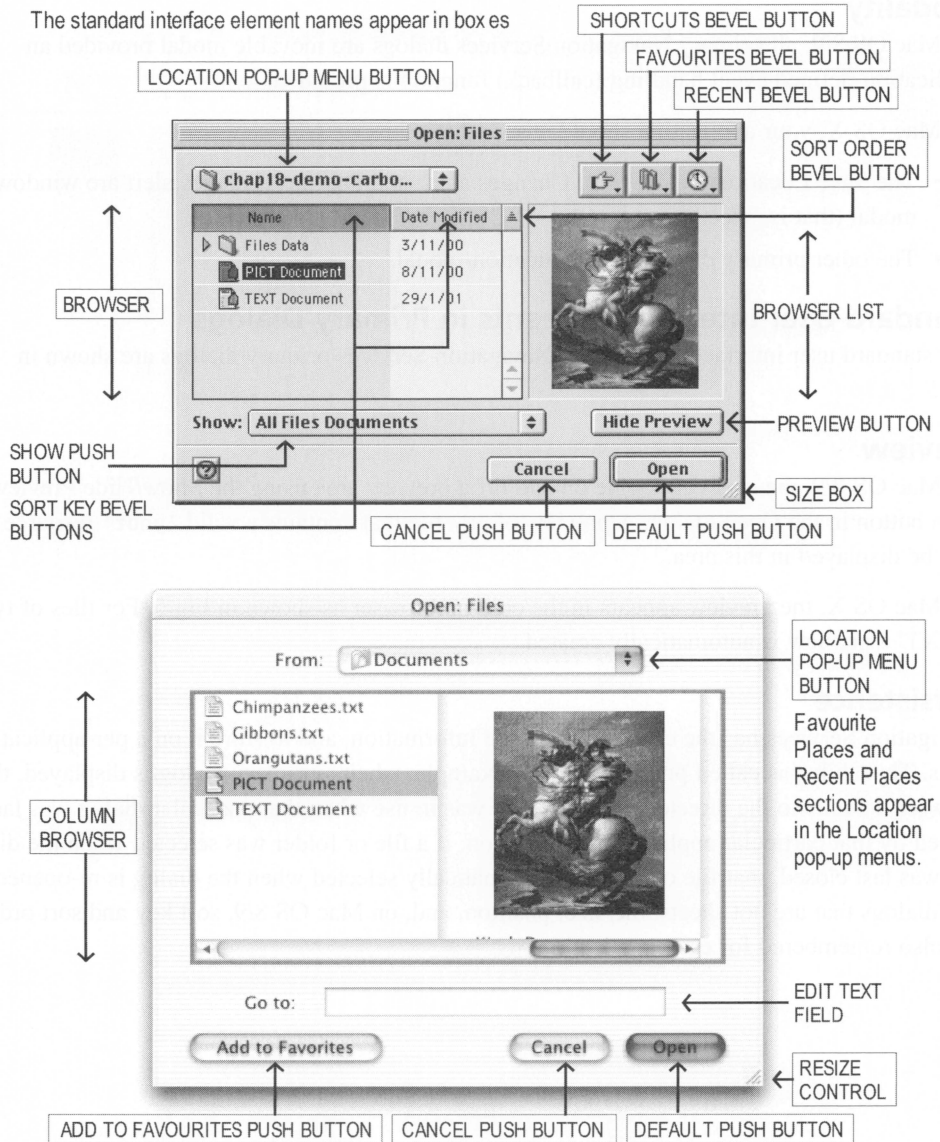
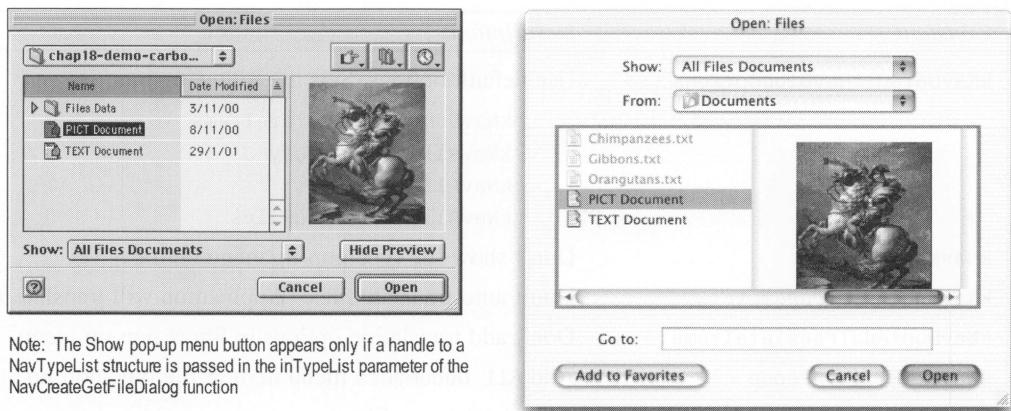


FIG 5 - STANDARD USER INTERFACE ELEMENTS IN NAVIGATION SERVICES DIALOGS

## Creating and Displaying an Open Dialog

The Open dialog (see Fig 6) is created by a call to `NavCreateGetFileDialog` and displayed by a call to `NavDialogRun`. You pass a universal procedure pointer to an application-defined event handling (callback) function in the `inEventProc` parameter of `NavCreateGetFileDialog`.



Note: The Show pop-up menu button appears only if a handle to a NavTypeList structure is passed in the inTypeList parameter of the NavCreateGetFileDialog function

FIG 6 - NAVIGATION SERVICES OPEN DIALOG

## The NavDialogCreationOptions Structure

You pass a pointer to a NavDialogCreationOptions structure, which specifies options controlling the appearance and behavior of the dialog, in the inOptions parameter of NavCreateGetFileDialog. The NavDialogCreationOptions structure is as follows:

```
struct NavDialogCreationOptions
{
    UInt16                version;
    NavDialogOptionFlags  optionFlags;
    Point                 location;
    CFStringRef            clientName;
    CFStringRef            windowTitle;
    CFStringRef            actionButtonLabel;
    CFStringRef            cancelButtonLabel;
    CFStringRef            saveFileName;
    CFStringRef            message;
    UInt32                preferenceKey;
    CFArrayRef             popupExtension;
    WindowModality        modality;
    WindowRef             parentWindow;
    char                  reserved[16];
};
typedef struct NavDialogCreationOptions NavDialogCreationOptions;
```

### Field Descriptions

**optionFlags** One of the following constants of type NavDialogOptionFlags:

<i>Constant</i>	<i>Description</i>
<code>kNavDefaultNavDlogOptions</code>	Use default options. Sets the following bits: <code>kNavDontAddTranslateItems</code> <code>kNavAllowStationery</code> <code>kNavAllowPreviews</code> <code>kNavAllowMultipleFiles</code>
<code>kNavNoTypePopup</code>	Don't show file type pop-up menu button.
<code>kNavDontAutoTranslate</code>	Don't auto-translate files. (Application will translate.)
<code>kNavDontAddTranslateItems</code>	Don't add translation options in Show pop-up menu.
<code>kNavAllFilesInPopup</code>	Add All Documents menu item in file type pop-up.
<code>kNavAllowStationery</code>	Allow stationery files.
<code>kNavAllowPreviews</code>	Allow preview to show.
<code>kNavAllowMultipleFiles</code>	Allow multiple items to be selected.
<code>kNavAllowInvisibleFiles</code>	Allow invisible items to be shown.
<code>kNavDontResolveAliases</code>	Don't resolve aliases.
<code>kNavSelectDefaultLocation</code>	Make the default location the browser selection.
<code>kNavSelectAllReadableItem</code>	Make dialog select All Readable Documents on open.
<code>kNavSupportPackages</code>	Recognize file system packages.
<code>kNavAllowOpenPackages</code>	Allow opening of packages.
<code>kNavDontAddRecents</code>	Don't add chosen objects to Recents list.
<code>kNavDontUseCustomFrame</code>	Don't draw the custom area bevel frame.
<code>kNavDontConfirmReplacement</code>	Don't show the "Replace File?" alert on save conflict.

**location** Location of the upper-left of the dialog (global coordinates). The dialog will appear at the location at which it was last closed if the `optionFlags` field is assigned NULL or this field is assigned `(-1, -1)`.

**clientName** Name of your application. This will appear in the dialog's title bar.

**windowTitle** Overrides the default window title.

**actionButtonLabel** Title for the dialog's OK push button. If a title is not assigned, the push button will use the default title (Open or Save).

**cancelButtonLabel** Title for the dialog's Cancel push button. If a title is not assigned, the push button will use the default title (Cancel).

**savedFileName** Default file name for a saved file.

**message** A string, which is displayed in the dialog, providing additional instructions to the user. (For an example, see Fig 11).

**preferenceKey** A value that identifies the set of dialog preferences that should be used. Assign 0 if you do not wish to provide a preference key.

**popupExtension** A handle to one or more structures of type `NavMenuItemSpec` used to add extra menu items to an Open dialog's Show pop-up menu or a Save Location dialog's Format pop-up menu.

**modality** The dialog's modality (relevant on Mac OS X only). Relevant Window Manager constants are:

```
kWindowModalityNone
kWindowModalitySystemModal
kWindowModalityAppModal
kWindowModalityWindowModal
```

**parentWindow** The dialog's parent window. (Relevant on Mac OS X only when the dialog is window-modal.)

The function `NavGetDefaultDialogCreationOptions` may be called to initialise a structure of type `NavDialogCreationOptions` with the default dialog options, which are as follows:

- Show and Format pop-up menu buttons are displayed in the Open and Save Location dialogs (Mac OS 8/9).
- Files are auto-translated. (This implies that the application will not translate.)
- Translation options are not included in the Show pop-up menu in the Open dialog.
- The All Documents item is not included in the Show pop-up menu in the Open dialog.
- The Stationery Option item is included in the Format pop-up menu in the Save Location dialog.
- Previews of selected files, when available, are displayed in the Open dialog.
- Selection of multiple files in the browser list/column browser in the Open dialog is allowed.
- Invisible files are not displayed.
- Aliases are not resolved.
- The default location in the browser list/column browser is not selected.
- The All Readable Documents is not made the default selection in the Show pop-up menu in the Open dialog.
- File system packages are not displayed.

- File system packages cannot be opened and navigated.
- Chosen file objects are added to the Recents list.
- A border is drawn around the custom area.
- The default titles for the OK and Cancel buttons are used.
- No message is displayed in the dialog.

## The Show Pop-up Menu

The types of files to be displayed in the browser list may be chosen from a list of available **file types** in the Show pop-up menu in the Open dialog (see Fig 7). This list is built from information supplied by your application in a structure of type `NavTypeList` (see below), a handle to which you pass in the `inTypeList` parameter of `NavCreateGetFileDialog`.

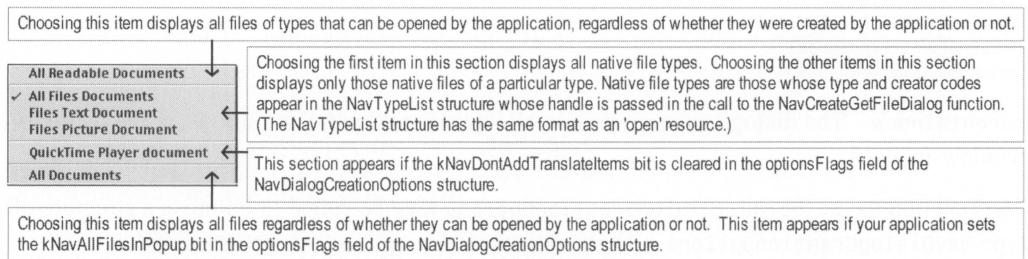


FIG 7 - THE SHOW POP-UP MENU AND FILE TYPE OPTIONS (MAC OS 8/9)

The Show pop-up menu button will not appear in the Open dialog if you pass `NULL` in the `inTypeList` parameter of the `NavCreateGetFileDialog` function or if you set the `kNavNoTypePopup` bit in the `optionsFlags` field of the `NavDialogCreationOptions` structure passed in the call to `NavCreateGetFileDialog`.

If a handle to a `NavTypeList` structure is passed in the `inTypeList` parameter and the `kNavNoTypePopup` bit is set

- All items in the browser will be deactivated except for the file types specified in the `NavTypeList` structure whether they were created by the application or not.
- The Show pop-up menu button will not appear.

## Native File Types Section

The first item in the **native file types** section of the Mac OS 8/9 Show pop-up menu defaults to All Known Documents if you do not assign the name of your application to the `clientName` field of the `NavDialogCreationOptions` structure passed in the `dialogOptions` parameter of the `NavCreateGetFileDialog` function.

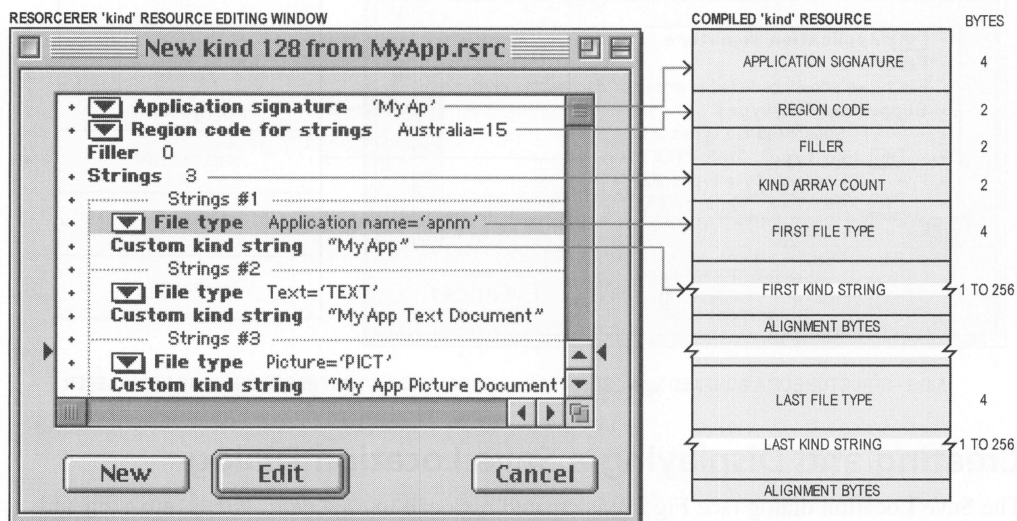
The remaining items in the native file types section will default to `<Application Name> Document` unless you provide **kind strings** to describe the file types included in your



NavTypeList structure. For Mac OS 8/9, you can do this by including a **kind resource** (a resource of type 'kind') in your application's resource fork. Fig 8 shows the structure of a compiled 'kind' resource and such a resource being created using Resorcerer.

## NOTE

The kind strings from your application's 'kind' resource also appear in the Kind column in Finder window list views.



Note: The special file type 'apnm' has been included so that, whenever Navigation Services encounters a document that belongs to your application, but whose file type has not been included in the 'kind' resource, a kind string in the form "<application name> document" will be generated.

FIG 8 - STRUCTURE OF A COMPILED 'kind' RESOURCE AND CREATING A 'kind' RESOURCE USING RESORCERER

For Mac OS X, the 'kind' resource is ignored if you provide necessary information in your application's 'plst' resource. The relevant keys are CFBundleDevelopmentRegion, CFBundleSignature, and CFBundleDocumentTypes. 'apnm' as a CFBundleTypeOSTypes has same effect as in 'kind' resource.

## The NavTypeList Structure

The NavTypeList structure, which defines the list of file types that your application is capable of opening, is as follows:

```
struct NavTypeList
{
    OSType componentSignature; // Your application signature.
    short reserved;
    short osTypeCount; // How many file types will be defined.
```



```

OSType osType[1];           // A list of file types your application can open.
};
typedef struct NavTypeList NavTypeList;
typedef NavTypeList *NavTypeListPtr;
typedef NavTypeListPtr *NavTypeListHandle;

```

You can create your file type list dynamically or you can use an 'open' resource. Fig 9 shows the structure of a compiled 'open' resource and such a resource being created using Resorcerer.

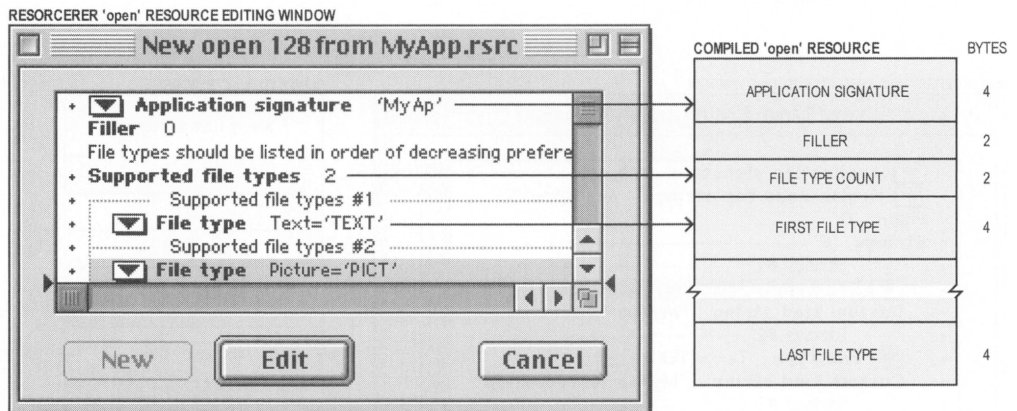


FIG 9 - STRUCTURE OF A COMPILED 'open' RESOURCE AND CREATING AN 'open' RESOURCE USING RESORCERER

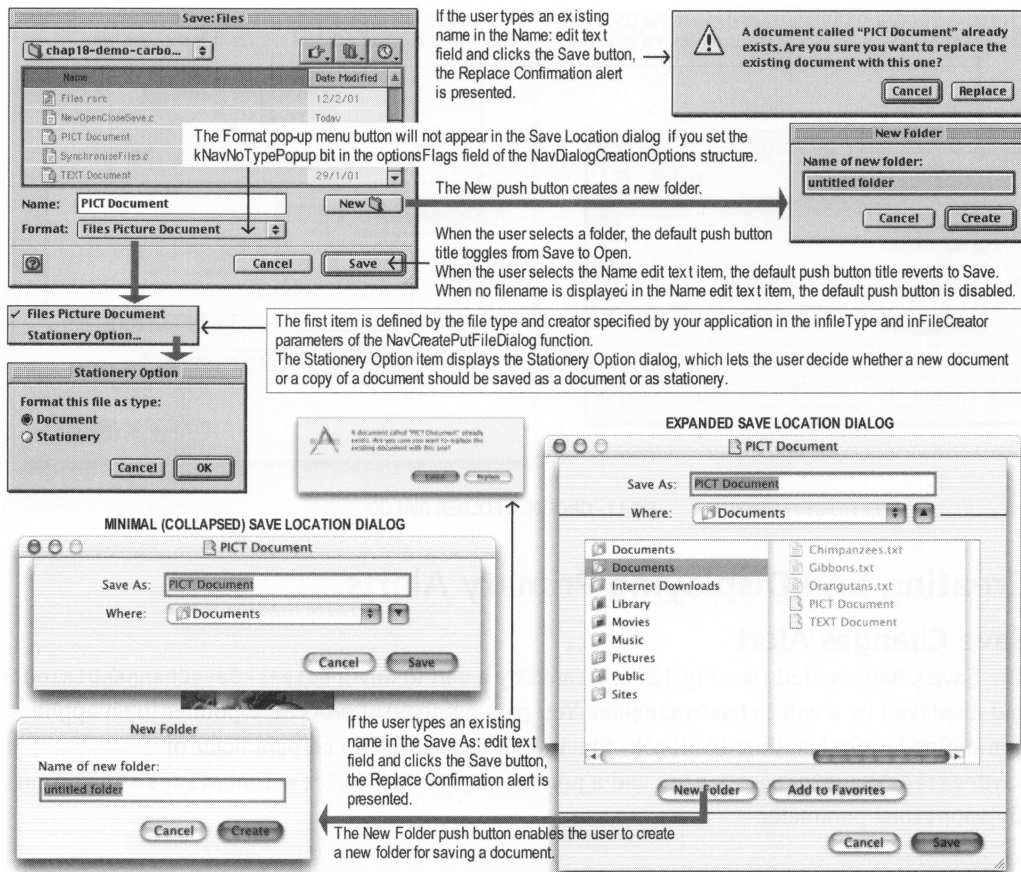
## Creating and Displaying a Save Location Dialog

The Save Location dialog (see Fig 10) is created by a call to `NavCreatePutFileDialog` and displayed by a call to `NavDialogRun`. You pass a universal procedure pointer to an application-defined event handling (callback) function in the `inEventProc` parameter of `NavCreatePutFileDialog`.

As with `NavCreateGetFileDialog`, you pass a pointer to a `NavDialogCreationOptions` structure in the `inOptions` parameter of `NavCreatePutFileDialog`. Other parameters allow you to specify file type and file creator.

## Creating and Displaying a Choose a Folder Dialog

The Choose a Folder dialog (see Fig 11) is created by a call to `NavCreateChooseFolderDialog` and displayed by a call to `NavDialogRun`. You pass a universal procedure pointer to an application-defined event handling (callback) function in the `inEventProc` parameter of `NavCreateChooseFolderDialog` and a pointer to a `NavDialogCreationOptions` structure in the `inOptions` parameter.



**FIG 10 - THE SAVE LOCATION DIALOG BOX (PARTIAL) AND ASSOCIATED DIALOGS AND ALERTS**

The other dialogs in the Choose family are created and displayed in a similar manner:

- The Choose a Volume dialog is created by a call to `NavCreateChooseVolumeDialog`.
- The Choose a File dialog is created by a call to `NavCreateChooseFileDialog`, and may be used when you want the user to select a file for a purpose other than opening. The file could be, for example, a preferences file or a dictionary file.
- The Choose a File Object dialog is created by a call to `NavCreateChooseObjectDialog`, and may be used when you need the user to select an object that might be one of several different types.

The browser list (Mac OS 8/9) and column browser (Mac OS X) in the Choose a Folder dialog displays only directories and volumes.

If a string is assigned to the message field of the NavDialogCreationOptions structure, it is displayed here.

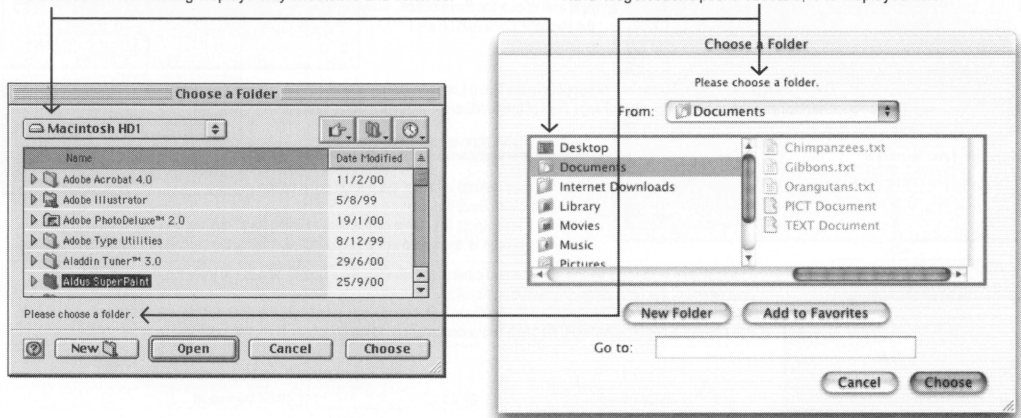


FIG 11 - CHOOSE A FOLDER DIALOG

## Creating and Displaying Primary Alerts

### Save Changes Alert

The Save Changes alert (see Fig 12) is created by a call to NavCreateAskSaveChangesDialog and displayed by a call to NavDialogRun. You pass a universal procedure pointer to an application-defined event handling (callback) function in the inEventProc parameter of NavCreateAskSaveChangesDialog and a pointer to a NavDialogCreationOptions structure in the inOptions parameter.

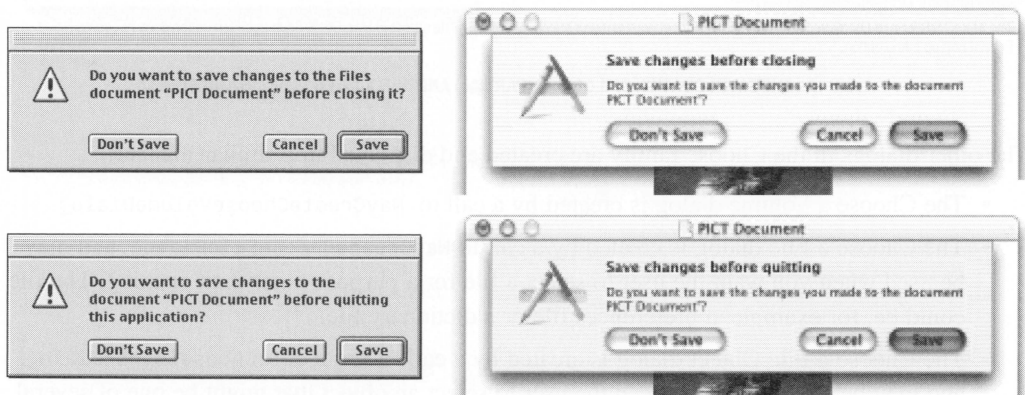


FIG 12 - SAVE CHANGES ALERTS (CLOSING DOCUMENT AND QUITTING APPLICATION)

One of the following constants is passed in the `inAction` parameter of the `NavCreateAskSaveChangesDialog` function:

```
kNavSaveChangesClosingDocument    = 1
kNavSaveChangesQuittingApplication = 2
kNavSaveChangesOther               = 0
```

## Discard Changes Alert

To support the Revert command in your application's File menu, Navigation Services provides the Discard Changes alert. The Discard Changes alert (see Fig 13) is created by a call to `NavCreateAskDiscardChangesDialog` and displayed by a call to `NavDialogRun`. You pass a universal procedure pointer to an application-defined event handling (callback) function in the `inEventProc` parameter of `NavCreateAskDiscardChangesDialog` and a pointer to a `NavDialogCreationOptions` structure in the `inOptions` parameter.

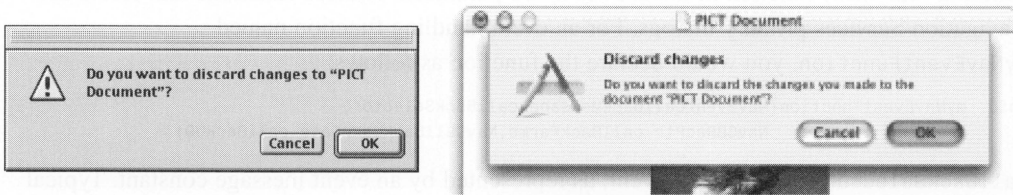


FIG 13 - DISCARD CHANGES ALERT

## Review Changes Alert—Mac OS X

On Mac OS X, when the user attempts to quit your application when there is more than one document with unsaved changes open, your application should present a Review Changes alert (see Fig 14). No Navigation Services creation function existed at the time of writing; accordingly, at the time of writing, it was necessary to create, display, and handle this alert using `StandardAlert` or `CreateStandardAlert`.

A click on the Discard Changes button should cause all windows to close (without saving changes) and the application to close down. A click on the Cancel button should cancel the Quit command, keeping the application running. A click on the Review Changes button should cause each window with unsaved changes to be sequentially presented to the user with a Save Changes alert presented.

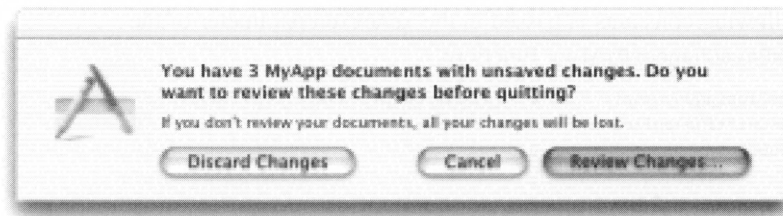


FIG 14 - REVIEW UNSAVED ALERT

## Event Handling in the Primary Dialogs

### Event-Handling Function

As previously stated, you pass a universal procedure pointer to an application-defined event handling (callback) function in the `inEventProc` parameter of those functions that create the Navigation Services primary dialogs. For an event handling function named `myNavEventFunction`, you would declare the function as follows:

```
void myNavEventFunction(NavEventCallbackMessage callBackSelector,
                       NavCBRecPtr callBackParms, NavCallBackUserData callBackUD)
```

**callBackSelector** The type of event, as represented by an event message constant. Typical event message constants and their meanings are as follows:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kNavCBUserAction</code>	12	The user has taken an action such as clicking on an Open or Save button.
<code>kNavCBEvent</code>	0	An event has occurred. Receipt of this event type allows your handler to update other windows, track controls, etc.
<code>kNavCBTerminate</code>	3	The dialog is about to be closed.

**callBackParms** A pointer to a `NavCBRec` structure, which contains data used by your application to process the event:

```
struct NavCBRec
{
    UInt16      version;
    NavDialogRef context;
    WindowRef   window;
    Rect        customRect;
    Rect        previewRect;
    NavEventData eventData;
    NavUserAction userAction;
    char        reserved[218];
};
typedef struct NavCBRec NavCBRec;
typedef NavCBRec *NavCBRecPtr;
```

**callbackUD** A pointer to a value passed in the `inClientData` parameter of the dialog creation functions.

## kNavCBUserAction Message Received

When the `kNavCBUserAction` message is received, your application typically calls `NavDialogGetReply` to obtain the results of the dialog session, which are returned in a `NavReplyRecord` structure.

### The NavReplyRecord Structure

```
struct NavReplyRecord
{
    UInt16          version;
    Boolean          validRecord;
    Boolean          replacing;
    Boolean          isStationery;
    Boolean          translationNeeded;
    AEDescList       selection;
    ScriptCode       keyScript;
    FileTranslationSpecArrayHandle fileTranslation;
    UInt32           reserved1;
    CFStringRef       saveFileName;
    char             reserved[227];
};
typedef struct NavReplyRecord NavReplyRecord;
```

### Field Descriptions

**validRecord** true if the user closed a dialog by clicking the Open button in an Open dialog, the Save button in a Save Location dialog, or the Choose button in a Choose dialog, or by pressing the Return or Enter key. If this field is false, the remaining fields do not contain valid data.

**replacing** true if the user chooses to save a file by replacing an existing file.

**isStationery** true if the file about to be saved should be saved as a stationery document.

**translationNeeded** true if translation was or will be needed for selected files in Open and Save Location dialogs.

**selection** An Apple event descriptor list (`AEDescList`) created from `FSSpec` or `FSRef` references to selected items. You can determine the number of items in the list by calling `AECCountItems`. Each selected item is described in an `AEDesc` structure by the descriptor type `typeFSS` or `typeFSRef`. This descriptor can be coerced into an `FSSpec` or `FSRef` preparatory to, for example, opening the file.

**keyScript** Keyboard script system used for the filename.

**fileTranslation** Handle to a `FileTranslationSpec` structure, which contains a corresponding translation array for each file reference returned in the `selection` field.



`saveFileName` The save file name in CFString form.

This field was introduced with Navigation Services 3.0 because there is no way to fit a 255-character Unicode name into the name field of an FSSpec or into an FSRef. (See selection field.)

**Note 1:** On Mac OS 9, you will never get a file name that won't fit into the name field of an FSSpec structure.

**Note 2:** On Mac OS X, you cannot reliably convert the name in the `saveFileName` field to a 31-byte Pascal string.

When your application has finished using this structure, it should dispose of it by calling the function `NavDisposeReply`.

### Responding to User Actions

If the `validRecord` field of the `NavReplyRecord` structure contains true, your application typically calls `NavDialogGetUserAction` to determine the user action, as represented by user action constants. Typical user action constants are as follows:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kUserActionCancel</code>	1	The user clicked the Cancel button.
<code>kUserActionOpen</code>	2	The user clicked the Open button in an Open dialog.
<code>kUserActionSaveAs</code>	3	The user clicked the Save button in a Save Location dialog.
<code>kUserActionChoose</code>	4	The user clicked the Choose button in a Choose dialog

As an alternative to calling `NavDialogGetUserAction`, you can extract the user action from the `userAction` field of the `NavCBRec` structure.

After determining the user action, your event handling function should take the appropriate action. For example, if the Open button was clicked, your event handling function should proceed to open the file, or files, selected by the user in the Open dialog.

You should always call the function `NavCompleteSave` to complete any save operation. Amongst other things, `NavCompleteSave` performs any needed translation.

### kNavCBTerminate Message Received

When the `kNavCBTerminate` message is received, your event handler should call `NavDialogDispose` to dispose of the dialog reference.

## Event Handling in Primary Alerts

Your event handling function for the primary alerts should be declared in the same way as that for the event handling function for the primary dialogs.

When the `kNavCBUserAction` message is received, your application should call `NavDialogGetUserAction` to determine the user action, and then take the appropriate action. The user action constants relevant to the primary alerts are as follows:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kUserActionCancel</code>	1	The user clicked the Cancel button.
<code>kUserActionSaveChanges</code>	6	The user clicked the Save button in a Save Changes alert.
<code>kUserActionDontSaveChanges</code>	7	The user clicked the Don't Save button in a Save Changes alert.
<code>kUserActionDiscardChanges</code>	8	The user clicked the OK button in a Discard Changes alert.

When the appropriate action has been taken, your event handler should call `NavDialogDispose` to dispose of the dialog reference.

## Other Application-Defined (Callback) Functions

### Application-Defined Object Filtering

If your application needs simple, straightforward object filtering, and as previously described, you simply pass a pointer to a structure of type `NavTypeList` to the relevant Navigation Services function (`NavCreateGetFileDialog` or `NavCreateChooseFileDialog`). If you want more specific filtering, you can provide an application-defined filter (callback) function. Filter functions give you more control over what can and cannot be displayed. You can pass a universal procedure pointer to your filter function in calls to the functions `NavCreateGetFileDialog`, `NavCreateChooseFileDialog`, `NavCreateChooseFolderDialog`, `NavCreateChooseVolumeDialog`, and `NavCreateChooseObjectDialog`.

You can use both a `NavTypeList` structure and a filter function for the Open and Choose a File dialogs if you wish, but be aware that your filter function is directly affected by the `NavTypeList` structure. For example, if the `NavTypeList` structure contains only 'TEXT' and 'PICT' types, only 'TEXT' and 'PICT' files will be passed into your filter function.



Your filter function should return `true` if an object is to be displayed. The following is an example of a filter function that allows only text files to be displayed:

```
Boolean myNavFilterCallback(AEDesc *theItem, void *info, void *callBackUD,
                           NavFilterModes filterMode)
{
    OSErr          theErr = noErr;
    Boolean         display = true;
    NavFileOrFolderInfo *theInfo;

    theInfo = (NavFileOrFolderInfo *) info;
    if(theItem->descriptorType == typeFSS)
        if(!theInfo->isFolder)
            if(theInfo->fileAndFolder.fileInfo.finderInfo.fdType != 'TEXT')
                display = false;

    return display;
}
```

## Application-Defined (Callback) Previews

To override how previews are drawn and handled, you can create a preview function and pass a universal procedure pointer to it in the `inpreviewProc` parameter of the Navigation Services functions `NavCreateGetFileDialog`, `NavCreateChooseFileDialog` and `NavCreateChooseObjectDialog`:

```
Boolean myPreviewProc(NavCBRecPtr callBackParms, void *callBackUD);
```

**callBackParms** A pointer to a `NavCBRec` structure that contains event data needed for your function to draw the preview.

**callBackUD** A value set by your application.

**Return:** `true` if your preview function successfully draws the file preview. If your preview function returns `false`, Navigation Services will display the preview if the file contains a valid 'pnot' resource.

# Main File Manager Constants, Data Types and Functions

## Constants

### Read/Write Permission

```
fsCurPerm    = 0
fsRdPerm      = 1
fsWrPerm      = 2
fsRdWrPerm    = 3
fsRdWrShPerm  = 4
```

## File Mark Positioning Modes

```
fsAtMark      = 0
fsFromStart   = 1
fsFromEOF     = 2
fsFromMark    = 3
rdVerify      = 64
```

## Data Types

### File System Specification Structure

```
struct FSSpec
{
    short      vRefNum;    // Volume reference number.
    long       parID;      // Directory ID of parent directory.
    Str63      name;       // Filename or directory name.
};
typedef struct FSSpec FSSpec;
typedef FSSpec *FSSpecPtr, **FSSpecHandle;
```

### File System Reference

```
struct FSRef
{
    UInt8 hidden[80];
}
```

### File Information Structure

```
struct FInfo
{
    OSType      fdType;    // File type.
    OSType      fdCreator;  // File's creator.
    unsigned short fdFlags; // Finder flags (fHasBundle, fInvisible, etc).
    Point       fdLocation; // Position of top-left corner of file's icon.
    short       fdFldr;    // Folder containing file.
};
typedef struct FInfo FInfo;
```

## Functions

### Reading, Writing and Closing Files

```
OSErr FSClose(short refNum);
OSErr FSRead(short refNum, long *count, void *buffPtr);
OSErr FSWrite(short refNum, long *count, const void *buffPtr);
```

### Manipulating the File Mark

```
OSErr GetFPos(short refNum, long *filePos);
OSErr SetFPos(short refNum, short posMode, long posOff);
```

### Manipulating the End-Of-File

```
OSErr GetEOF(short refNum, long *logEOF);
OSErr SetEOF(short refNum, long logEOF);
```

### Opening and Creating Files

```
OSErr FSpOpenDF(const FSSpec *spec, SInt8 permission, short *refNum);
OSErr FSpOpenRF(const FSSpec *spec, SInt8 permission, short *refNum);
OSErr FSpCreate(const FSSpec *spec, OSType creator, OSType fileType, ScriptCode scriptTag);
OSErr FSCreateFileUnicode(const FSRef *parentRef, UniCharCount nameLength, const UniChar *name,
    FSCatalogInfoBitmap whichInfo, const FSCatalogInfo *catalogInfo, FSRef *newRef,
    FSSpec *newSpec);
```

### Deleting Files and Directories

```
OSErr FSpDelete(const FSSpec *spec);
OSErr FSDeleteObject(const FSRef *ref);
```

### Exchanging Data in Two Files

```
OSErr FSpExchangeFiles(const FSSpec *source, const FSSpec *dest);
OSErr FSExchangeObjects(const FSRef *ref, const FSRef *destRef);
```

### Creating File System Specifications and File System References

```
OSErr FSpMakeFSSpec(short vRefNum, long dirID, ConstStr255Param fileName, FSSpec *spec);
OSErr FSpMakeFSRef(const FSSpec *source, FSRef *newRef);
OSErr FSpMakeFSRefUnicode(const FSRef *parentRef, UniCharCount nameLength, const UniChar *name,
    TextEncoding textEncodingHint, FSRef *newRef)
```

### Obtaining Volume Information

```
OSErr GetVInfo(short drvNum, StringPtr volName, short *vRefNum, long *freeBytes);
OSErr GetVRefNum(short fileRefNum, short *vRefNum);
```

### Getting and Setting Finder Information

```
OSErr FSpGetFInfo(FSSpec *spec, FInfo *fndrInfo);
OSErr FSpSetFInfo(const FSSpec *spec, const FInfo *fndrInfo);
```

## Relevant Resource Manager Functions

### Creating and Opening Resource Files

```
void FSpCreateResFile(const FSSpec *spec, OSType creator, OSType fileType,
    ScriptCode scriptTag);
short FSpOpenResFile(const FSSpec *spec, SignedByte permission);
```

## Relevant Finder Interface Functions

### Find a Specified Folder

```
OSErr FindFolder(short vRefNum, OSType folderType, Boolean createFolder,
    short *foundVRefNum, long *foundDirID)
```

# Main Navigation Services Constants, Data Types, and Functions

## Constants

### Dialog Option Flags

kNavDefaultNavDlogOptions	= 0x000000E4
kNavNoTypePopup	= 0x00000001
kNavDontAutoTranslate	= 0x00000002
kNavDontAddTranslateItems	= 0x00000004
kNavAllFilesInPopup	= 0x00000010
kNavAllowStationery	= 0x00000020
kNavAllowPreviews	= 0x00000040
kNavAllowMultipleFiles	= 0x00000080
kNavAllowInvisibleFiles	= 0x00000100
kNavDontResolveAliases	= 0x00000200
kNavSelectDefaultLocation	= 0x00000400
kNavSelectAllReadableItem	= 0x00000800
kNavSupportPackages	= 0x00001000
kNavAllowOpenPackages	= 0x00002000
kNavDontAddRecents	= 0x00004000
kNavDontUseCustomFrame	= 0x00008000
kNavDontConfirmReplacement	= 0x00010000

### Event Messages

kNavCBEvent	= 0
kNavCBCustomize	= 1
kNavCBStart	= 2
kNavCBTerminate	= 3
kNavCBAdjustRect	= 4
kNavCBNewLocation	= 5
kNavCBShowDesktop	= 6
kNavCBSelectEntry	= 7
kNavCBPopupMenuSelect	= 8
kNavCBAccept	= 9
kNavCBCancel	= 10
kNavCBAdjustPreview	= 11
kNavCBUserAction	= 12
kNavCBOpenSelection	= (long) 0x80000000

### User Action

kNavUserActionNone	= 0
kNavUserActionCancel	= 1
kNavUserActionOpen	= 2
kNavUserActionSaveAs	= 3
kNavUserActionChoose	= 4
kNavUserActionNewFolder	= 5
kNavUserActionSaveChanges	= 6
kNavUserActionDontSaveChanges	= 7
kNavUserActionDiscardChanges	= 8

## Save Changes Action

```
kNavSaveChangesClosingDocument    = 1
kNavSaveChangesQuittingApplication = 2
```

## Data Types

```
typedef struct __NavDialog *NavDialogRef;
typedef UInt32             NavDialogOptionFlags;
typedef SInt32             NavEventCallbackMessage;
typedef void               *NavCallBackUserData;
typedef UInt32             NavUserAction;
typedef UInt32             NavAskSaveChangesAction;
```

## NavDialogCreationOptions

```
struct NavDialogCreationOptions
{
    UInt16             version;
    NavDialogOptionFlags optionFlags;
    Point              location;
    CFStringRef         clientName;
    CFStringRef         windowTitle;
    CFStringRef         actionButtonLabel;
    CFStringRef         cancelButtonLabel;
    CFStringRef         saveFileName;
    CFStringRef         message;
    UInt32              preferenceKey;
    CFArrayRef          popupExtension;
    WindowModality      modality;
    WindowRef           parentWindow;
    char                reserved[16];
};
typedef struct NavDialogCreationOptions NavDialogCreationOptions;
```

## NavTypeList

```
struct NavTypeList
{
    OSType componentSignature;
    short reserved;
    short osTypeCount;
    OSType osType[1];
};
typedef struct NavTypeList NavTypeList;
typedef NavTypeList *NavTypeListPtr;
typedef NavTypeListPtr *NavTypeListHandle;
```

## NavCBRec

```
struct NavCBRec
{
    UInt16             version;
    NavDialogRef        context;
    WindowRef           window;
    Rect                customRect;
```

```

Rect          previewRect;
NavEventData  eventData;
NavUserAction userAction;
char          reserved[218];
};
typedef struct NavCBRec NavCBRec;
typedef NavCBRec *NavCBRecPtr;

```

## NavReplyRecord

```

struct NavReplyRecord
{
    UInt16          version;
    Boolean          validRecord;
    Boolean          replacing;
    Boolean          isStationery;
    Boolean          translationNeeded;
    AEDescList       selection;
    ScriptCode       keyScript;
    FileTranslationSpecArrayHandle fileTranslation;
    UInt32           reserved1;
    CFStringRef      saveFileName;
    char             reserved[227];
};
typedef struct NavReplyRecord NavReplyRecord;

```

## Functions

### Initializing the NavDialogCreationOptions Structure

```
OSStatus      NavGetDefaultDialogCreationOptions(NavDialogCreationOptions *outOptions);
```

### Creating and Disposing Of Navigation Services Dialogs

```

OSStatus      NavCreateGetFileDialog(const NavDialogCreationOptions *inOptions,
    NavTypeListHandle inTypeList,NavEventUPP inEventProc,NavPreviewUPP inPreviewProc,
    NavObjectFilterUPP inFilterProc,void *inClientData,NavDialogRef *outDialog);
OSStatus      NavCreatePutFileDialog(const NavDialogCreationOptions *inOptions,
    OSType inFileType,OSType inFileCreator,NavEventUPP inEventProc,
    void *inClientData,NavDialogRef *outDialog);
OSStatus      NavCreateAskSaveChangesDialog(const NavDialogCreationOptions *inOptions,
    NavAskSaveChangesAction inAction,NavEventUPP inEventProc,void *inClientData,
    NavDialogRef *outDialog);
OSStatus      NavCreateAskDiscardChangesDialog(const NavDialogCreationOptions *inOptions,
    NavEventUPP inEventProc,void *inClientData,NavDialogRef *outDialog);
OSStatus      NavCreateChooseFileDialog(const NavDialogCreationOptions *inOptions,
    NavTypeListHandle inTypeList,NavEventUPP inEventProc,NavPreviewUPP inPreviewProc,
    NavObjectFilterUPP inFilterProc,void *inClientData,NavDialogRef *outDialog);
OSStatus      NavCreateChooseVolumeDialog(const NavDialogCreationOptions *inOptions,
    NavEventUPP inEventProc,NavObjectFilterUPP inFilterProc,void *inClientData,
    NavDialogRef *outDialog);
OSStatus      NavCreateChooseObjectDialog(const NavDialogCreationOptions *inOptions,
    NavEventUPP inEventProc,NavPreviewUPP inPreviewProc,
    NavObjectFilterUPP inFilterProc,void *inClientData,NavDialogRef *outDialog);
void          NavDialogDispose(NavDialogRef inDialog);

```

## Displaying and Running a Navigation Services Dialog

```
OSStatus NavDialogRun(NavDialogRef inDialog);
```

## Filling In and Disposing Of NavReplyRecord Structures

```
OSStatus NavDialogGetReply(NavDialogRef inDialog, NavReplyRecord *outReply);
OSStatus NavDisposeReply(NavReplyRecord *reply);
```

## Getting the User Action

```
NavUserAction NavDialogGetUserAction(NavDialogRef inDialog);
```

## Getting and Setting the Save File Name

```
CFStringRef NavDialogGetSaveFileName(NavDialogRef inPutFileDialog);
OSStatus NavDialogSetSaveFileName(NavDialogRef inPutFileDialog, CFStringRef inFileName);
```

## Completing a Save Operation

```
OSStatus NavCompleteSave(NavReplyRecord *reply, NavTranslationOptions howToTranslate);
```

## Getting the Window In Which a Navigation Services Dialog Appears

```
WindowRef NavDialogGetWindow(NavDialogRef inDialog);
```

## Creating New Folders

```
OSStatus NavCreateNewFolderDialog(const NavDialogCreationOptions *inOptions,
    NavEventUPP inEventProc, void *inClientData, NavDialogRef *outDialog);
```

## Creating Previews

```
OSStatus NavCreatePreview(AEDesc *theObject, OSType previewDataType,
    const void *previewData, Size previewDataSize);
```

## Creating and Disposing of Universal Procedure Pointers

```
NavEventUPP NewNavEventUPP(NavEventProcPtr userRoutine);
NavPreviewUPP NewNavPreviewUPP(NavPreviewProcPtr userRoutine);
NavObjectFilterUPP NewNavObjectFilterUPP(NavObjectFilterProcPtr userRoutine);
void DisposeNavEventUPP(NavEventUPP userUPP);
void DisposeNavPreviewUPP(NavPreviewUPP userUPP);
void DisposeNavObjectFilterUPP(NavObjectFilterUPP userUPP);
```

## Application-Defined (Callback) Functions—Event Handling, Previews, and Filters

```
void myNavEventFunction(NavEventCallbackMessage callBackSelector,
    NavCBRecPtr callBackParms, void *callBackUD);
Boolean myNavPreviewFunction(NavCBRecPtr callBackParms, void *callBackUD);
Boolean myNavObjectFilterFunction(AEDesc *theItem, void *info, void *callBackUD,
    NavFilterModes filterMode);
```



## Demonstration Program Files Listing

```
// *****
// Files.h CARBON EVENT MODEL
// *****
//
// This program demonstrates:
//
// · File operations associated with:
//
// · The user invoking the Open..., Close, Save, Save As..., Revert, and Quit commands of a
//   typical application.
//
// · Handling of the required Apple events Open Application, Re-open Application, Open
//   Documents, Print Documents, and Quit Application.
//
// · File synchronisation.
//
// · The creation, display, and handling of Open, Save Location, Choose a Folder, Save
//   Changes, Discard Changes, and Review Unsavd dialogs and alerts using the new model
//   introduced with Navigation Services 3.0.
//
// To keep the code not specifically related to files and file-handling to a minimum, an item
// is included in the Demonstration menu which allows the user to simulate "touching" a window
// (that is, modifying the contents of the associated document). Choosing the first menu item
// in this menu sets the window-touched flag in the window's document structure to true and
// draws the text "WINDOW TOUCHED" in the window in a large font size, this latter so that the
// user can keep track of which windows have been "touched".
//
// This program is also, in part, an extension of the demonstration program Windows2 in that
// it also demonstrates certain file-related Window Manager features introduced with the Mac
// OS 8.5 Window Manager. These features are:
//
// · Window proxy icons.
//
// · Window path pop-up menus.
//
// Those sections of the source code relating to these features are identified with ///// at
// the right of each line.
//
// The program utilises the following resources:
//
// · A 'plst' resource containing an information property list which provides information
//   to the Mac OS X Finder.
//
// · An 'MBAR' resource, and 'MENU' and 'xmnu' resources for Apple, File, Edit and
//   Demonstration menus (preload, non-purgeable).
//
// · A 'STR ' resource containing the "missing application name" string, which is copied to
//   all document files created by the program.
//
```

```

// · 'STR#' resources (purgeable) containing error strings, the application's name (for
//   certain Navigation Services functions), and a message string for the Choose a Folder
//   dialog.
//
// · An 'open' resource (purgeable) containing the file type list for the Open dialog.
//
// · A 'kind' resource (purgeable) describing file types, which is used by Navigation
//   Services to build the native file types section of the Show pop-up menu in the Open
//   dialog.
//
// · Two 'pnot' resources (purgeable) which, together with an associated 'PICT' resource
//   (purgeable) and a 'TEXT' resource created by the program, provide the previews for
//   the PICT and, on Mac OS 8/9, TEXT files.
//
// · The 'BNDL' resource (non-purgeable), 'FREF' resources (non-purgeable), signature
//   resource (non-purgeable), and icon family resources (purgeable), required to support the
//   built application on Mac OS 8/9.
//
// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****
// ..... includes
#include <Carbon.h>

// ..... defines

#define rMenuBar                128
#define mAppleApplication      128
#define Apple_About            'abou'
#define mFile                  129
#define File_New                'new '
#define File_Open               'open'
#define File_Close              'clos'
#define File_Save               'save'
#define File_SaveAs             'sava'
#define File_Revert             'reve'
#define File_Quit               'quit'
#define iQuit                   12
#define mDemonstration          131
#define Demo_TouchWindow        'touc'
#define Demo_ChooseAFolderDialog 'choo'
#define rErrorStrings           128
#define eInstallHandler         1000
#define eMaxWindows             1001
#define eCantFindFinderProcess  1002
#define rMiscStrings            129
#define sApplicationName        1
#define sChooseAFolder          2
#define rOpenResource           128
#define kMaxWindows             10
#define kFileCreator             'Kjbb'

```

```

#define kFileTypeTEXT          'TEXT'
#define kFileTypePICT         'PICT'
#define kOpen                  0
#define kPrint                  1
#define MIN(a,b)               ((a) < (b) ? (a) : (b))

// ..... typedefs

typedef struct
{
    TEHandle    editStrucHdl;
    PicHandle   pictureHdl;
    SInt16      fileRefNum;
    FSSpec      fileFSSpec;
    AliasHandle  aliasHdl;
    Boolean     windowTouched;
    NavDialogRef modalToWindowNavDialogRef;
    NavEventUPP askSaveDiscardEventFunctionUPP;
    Boolean     isAskSaveChangesDialog;
} docStructure, *docStructurePointer, **docStructureHandle;

// ..... function prototypes

void    main                (void);
void    eventLoop           (void);
void    doPreliminaries     (void);
void    doInstallAEHandlers  (void);
OSStatus appEventHandler     (EventHandlerCallRef, EventRef, void *);
OSStatus windowEventHandler  (EventHandlerCallRef, EventRef, void *);
void    doIdle              (void);
void    doDrawContent        (WindowRef);
void    doMenuChoice         (MenuCommand);
void    doAdjustMenus        (void);
void    doErrorAlert         (SInt16);
void    doCopyPString        (Str255, Str255);
void    doConcatPStrings     (Str255, Str255);
void    doTouchWindow        (void);
OSErr   openAppEventHandler  (AppleEvent *, AppleEvent *, SInt32);
OSErr   reopenAppEventHandler (AppleEvent *, AppleEvent *, SInt32);
OSErr   openAndPrintDocsEventHandler (AppleEvent *, AppleEvent *, SInt32);
OSErr   quitAppEventHandler  (AppleEvent *, AppleEvent *, SInt32);
OSErr   doHasGotRequiredParams (AppleEvent *);
SInt16  doReviewChangesAlert (SInt16);

OSErr   doNewCommand         (void);
OSErr   doOpenCommand        (void);
OSErr   doCloseCommand       (NavAskSaveChangesAction);
OSErr   doSaveCommand        (void);
OSErr   doSaveAsCommand      (void);
OSErr   doRevertCommand      (void);

OSErr   doNewDocWindow       (Boolean, OSType, WindowRef *);
EventHandlerUPP doGetHandlerUPP (void);
OSErr   doCloseDocWindow     (WindowRef);
OSErr   doOpenFile           (FSSpec, OSType);

```

```

OSErr      doReadTextFile          (WindowRef);
OSErr      doReadPictFile          (WindowRef);
OSErr      doCreateAskSaveChangesDialog (WindowRef,docStructureHandle,NavAskSaveChangesAction);
OSErr      doSaveUsingFSSpec       (WindowRef,NavReplyRecord *);
OSErr      doSaveUsingFSRef        (WindowRef,NavReplyRecord *);
OSErr      doWriteFile             (WindowRef);
OSErr      doWriteTextData         (WindowRef,SInt16);
OSErr      doWritePictData         (WindowRef,SInt16);

void getFilePathEventFunction      (NavEventCallbackMessage,NavCBRecPtr,NavCallBackUserData);
void askSaveDiscardEventFunction  (NavEventCallbackMessage,NavCBRecPtr,NavCallBackUserData);

OSErr      doCopyResources         (WindowRef);
OSErr      doCopyAResource         (ResType,SInt16,SInt16,SInt16);

void        doSynchroniseFiles     (void);
OSErr      doChooseAFolderDialog   (void);

// *****
// Files.c
// *****

// ..... includes

#include "Files.h"

// ..... global variables

Boolean     gRunningOnX = false;
SInt16      gAppResFileRefNum;
NavEventUPP gGetFilePutFileEventFunctionUPP ;
Boolean     gQuittingApplication = false;

extern SInt16 gCurrentNumberOfWindows;
extern Rect   gDestRect,gViewRect;

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;
    MenuRef        menuRef;
    EventTypeSpec  applicationEvents[] = { { kEventClassApplication, kEventAppActivated },
                                           { kEventClassCommand,      kEventProcessCommand },
                                           { kEventClassMenu,         kEventMenuEnableItems } };

    EventLoopTimerRef timerRef;

    // ..... do preliminaries

    doPreliminaries();

    // ..... save application's resource file file reference number

    gAppResFileRefNum = CurResFile();

```

```

// ..... set up menu bar and menus

menubarHdl = GetNewMBar(rMenubar);
if(menubarHdl == NULL)
    doErrorAlert(MemError());
SetMenuBar(menubarHdl);
DrawMenuBar();

Gestalt(gestaltMenuMgrAttr,&response);
if(response & gestaltMenuMgrAquaLayoutMask)
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
    {
        DeleteMenuItem(menuRef,iQuit);
        DeleteMenuItem(menuRef,iQuit - 1);
    }

    gRunningOnX = true;
}
else
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
        SetMenuItemCommandID(menuRef,iQuit,kHICommandQuit);
}

// ..... install required Apple event handlers

doInstallAEHandlers();

// ..... install application event handler

InstallApplicationEventHandler(NewEventHandlerUPP((EventHandlerProcPtr) appEventHandler),
                             GetEventTypeCount(applicationEvents),applicationEvents,
                             0,NULL);

// ..... install a timer (for file synchronisation)

InstallEventLoopTimer(GetCurrentEventLoop(),0,TicksToEventTime(15),
                      NewEventLoopTimerUPP((EventLoopTimerProcPtr) doIdle),NULL,
                      &timerRef);

// ..... get universal procedure pointer to main Navigation Services services event function

gGetFilePutFileEventFunctionUPP =
    NewNavEventUPP((NavEventProcPtr) getFilePutFileEventFunction);

// ..... run application event loop

RunApplicationEventLoop();
}

```

```

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(448);
    InitCursor();
}

// ***** doInstallAEHandlers

void doInstallAEHandlers(void)
{
    OSErr osError;

    osError = AEInstallEventHandler(kCoreEventClass,kAEOpenApplication,
                                   NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) openAppEventHandler),
                                   0L,false);
    if(osError != noErr) doErrorAlert(eInstallHandler);

    osError = AEInstallEventHandler(kCoreEventClass,kAEReopenApplication,
                                   NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) reopenAppEventHandler),
                                   0L,false);
    if(osError != noErr) doErrorAlert(eInstallHandler);

    osError = AEInstallEventHandler(kCoreEventClass,kAEOpenDocuments,
                                   NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) openAndPrintDocsEventHandler),
                                   kOpen,false);
    if(osError != noErr) doErrorAlert(eInstallHandler);

    osError = AEInstallEventHandler(kCoreEventClass,kAEPrintDocuments,
                                   NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) openAndPrintDocsEventHandler),
                                   kPrint,false);
    if(osError != noErr) doErrorAlert(eInstallHandler);

    osError = AEInstallEventHandler(kCoreEventClass,kAEQuitApplication,
                                   NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
                                   0L,false);
    if(osError != noErr) doErrorAlert(eInstallHandler);
}

// ***** appEventHandler

OSStatus appEventHandler(EventHandlerCallRef eventHandlerCallRef,EventRef eventRef,
                        void * userData)
{
    OSStatus      result = eventNotHandledErr;
    UInt32        eventClass;
    UInt32        eventKind;
    HICommand     hiCommand;
    MenuID         menuID;
    MenuItemIndex  menuItem;

    eventClass = GetEventClass(eventRef);
    eventKind  = GetEventKind(eventRef);

```

```

switch(eventClass)
{
    case kEventClassApplication:
        if(eventKind == kEventAppActivated)
            SetThemeCursor(kThemeArrowCursor);
        break;

    case kEventClassCommand:
        if(eventKind == kEventProcessCommand)
        {
            GetEventParameter(eventRef, kEventParamDirectObject, typeHICCommand, NULL,
                               sizeof(HICCommand), NULL, &hiCommand);
            menuID = GetMenuID(hiCommand.menu.menuRef);
            menuItem = hiCommand.menu.menuItemIndex;
            if((hiCommand.commandID != kHICCommandQuit) &&
                (menuID >= mAppleApplication && menuID <= mDemonstration))
            {
                doMenuChoice(hiCommand.commandID);
                result = noErr;
            }
        }
        break;

    case kEventClassMenu:
        if(eventKind == kEventMenuEnableItems)
        {
            doAdjustMenus();
            result = noErr;
        }
        break;
}

return result;
}

// ***** windowEventHandler

OSStatus windowEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                           void* userData)
{
    OSStatus result = eventNotHandledErr;
    UInt32 eventClass;
    UInt32 eventKind;
    WindowRef windowRef;

    eventClass = GetEventClass(eventRef);
    eventKind = GetEventKind(eventRef);

    switch(eventClass)
    {
        case kEventClassWindow:
            GetEventParameter(eventRef, kEventParamDirectObject, typeWindowRef, NULL, sizeof(windowRef),
                               NULL, &windowRef);

```



```

        switch(eventKind)
        {
            case kEventWindowDrawContent:
                doDrawContent(windowRef);
                result = noErr;
                break;

            case kEventWindowClose:
                if(gQuittingApplication)
                    doCloseCommand(kNavSaveChangesQuittingApplication);
                else
                    doCloseCommand(kNavSaveChangesClosingDocument);
                result = noErr;
                break;
        }
        break;
    }

    return result;
}

// ***** doIdle

void doIdle(void)
{
    if(GetWindowKind(FrontWindow()) == kApplicationWindowKind)
        doSynchroniseFiles();
}

// ***** doUpdate

void doDrawContent(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    GrafPtr            oldPort;
    Rect               destRect;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    if((*docStrucHdl)->pictureHdl)
    {
        destRect = ((*docStrucHdl)->pictureHdl)->picFrame;
        OffsetRect(&destRect, 170, 54);
        HLock((Handle) (*docStrucHdl)->pictureHdl);
        DrawPicture((*docStrucHdl)->pictureHdl, &destRect);
        HUnlock((Handle) (*docStrucHdl)->pictureHdl);
    }
    else if((*docStrucHdl)->editStrucHdl)
    {
        HLock((Handle) (*docStrucHdl)->editStrucHdl);
        TEUpdate(&gDestRect, (*docStrucHdl)->editStrucHdl);
        HUnlock((Handle) (*docStrucHdl)->editStrucHdl);
    }
}

```

```

if ((*docStrucHdl)->windowTouched)
{
    TextSize(48);
    MoveTo(30,170);
    DrawString("\pWINDOW TOUCHED");
    TextSize(12);
}

SetPort(oldPort);
}

// ***** doMenuChoice *****

void doMenuChoice(MenuCommand commandID)
{
    OSErr osError = noErr;

    switch(commandID)
    {
        // ..... Apple/Application menu .....

        case Apple_About:
            SysBeep(10);
            break;

        // ..... File menu .....

        case File_New:
            if(osError = doNewCommand())
                doErrorAlert(osError);
            break;

        case File_Open:
            if(osError = doOpenCommand() && osError == opWrErr)
                doErrorAlert(osError);
            break;

        case File_Close:
            if(osError = doCloseCommand(kNavSaveChangesClosingDocument))
                doErrorAlert(osError);
            break;

        case File_Save:
            if(osError = doSaveCommand())
                doErrorAlert(osError);
            break;

        case File_SaveAs:
            if(osError = doSaveAsCommand())
                doErrorAlert(osError);
            break;

        case File_Revert:
            if(osError = doRevertCommand())
                doErrorAlert(osError);
            break;
    }
}

```

```

// ..... Demonstration menu

case Demo_TouchWindow:
    doTouchWindow();
    break;

case Demo_ChooseAFolderDialog:
    if(osError = doChooseAFolderDialog())
        doErrorAlert(osError);
    break;
}
}

// ***** doAdjustMenus

void doAdjustMenus(void)
{
    OSErr          osError;
    MenuRef         menuRef;
    WindowRef       windowRef;
    docStructureHandle docStrucHdl;

    if(gCurrentNumberOfWindows > 0)
    {
        if(gRunningOnX)
        {
            if((osError = GetSheetWindowParent(FrontWindow(), &windowRef)) == noErr)
            {
                menuRef = GetMenuRef(mFile);
                DisableMenuCommand(menuRef, File_Close);
                DisableMenuCommand(menuRef, File_Save);
                DisableMenuCommand(menuRef, File_SaveAs);
                DisableMenuCommand(menuRef, File_Revert);
                menuRef = GetMenuRef(mDemonstration);
                DisableMenuCommand(menuRef, Demo_TouchWindow);
                return;
            }
            else
                windowRef = FrontWindow();
        }
        else
            windowRef = FrontWindow();

        if(GetWindowKind(windowRef) == kApplicationWindowKind)
        {
            docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

            menuRef = GetMenuRef(mFile);
            EnableMenuCommand(menuRef, File_Close);
            if((*docStrucHdl) -> windowTouched)
            {
                EnableMenuCommand(menuRef, File_Save);
                EnableMenuCommand(menuRef, File_Revert);
            }
        }
    }
}

```

```

else
{
    DisableMenuCommand(menuRef,File_Save);
    DisableMenuCommand(menuRef,File_Revert);
}

if((*docStrucHdl)->pictureHdl != NULL) ||
    ((*docStrucHdl)->editStrucHdl->teLength > 0))
    EnableMenuCommand(menuRef,File_SaveAs);
else
    DisableMenuCommand(menuRef,File_SaveAs);

menuRef = GetMenuRef(mDemonstration);

if((*docStrucHdl)->pictureHdl != NULL) ||
    ((*docStrucHdl)->editStrucHdl->teLength > 0))
{
    if((*docStrucHdl)->windowTouched == false)
        EnableMenuCommand(menuRef,Demo_TouchWindow);
    else
        DisableMenuCommand(menuRef,Demo_TouchWindow);
}
else
    DisableMenuCommand(menuRef,Demo_TouchWindow);
}
}
else
{
    menuRef = GetMenuRef(mFile);
    DisableMenuCommand(menuRef,File_Close);
    DisableMenuCommand(menuRef,File_Save);
    DisableMenuCommand(menuRef,File_SaveAs);
    DisableMenuCommand(menuRef,File_Revert);
    menuRef = GetMenuRef(mDemonstration);
    DisableMenuCommand(menuRef,Demo_TouchWindow);
}

DrawMenuBar();
}

// ***** doErrorAlert

void doErrorAlert(SInt16 errorCode)
{
    Str255 errorString, theString;
    SInt16 itemHit;

    if(errorCode == eInstallHandler)
        GetIndString(errorString,rErrorStrings,1);
    else if(errorCode == eMaxWindows)
        GetIndString(errorString,rErrorStrings,2);
    else if(errorCode == eCantFindFinderProcess)
        GetIndString(errorString,rErrorStrings,3);
}

```

```

else if(errorCode == opWrErr)
    GetIndString(errorString,rErrorStrings,4);
else
{
    GetIndString(errorString,rErrorStrings,5);
    NumToString((SInt32) errorCode,theString);
    doConcatPStrings(errorString,theString);
}

if(errorCode != memFullErr)
{
    StandardAlert(kAlertCautionAlert,errorString,NULL,NULL,&itemHit);
}
else
{
    StandardAlert(kAlertStopAlert,errorString,NULL,NULL,&itemHit);
    ExitToShell();
}
}

// ***** doCopyPString

void doCopyPString(Str255 sourceString,Str255 destinationString)
{
    SInt16 stringLength;

    stringLength = sourceString[0];
    BlockMove(sourceString + 1,destinationString + 1,stringLength);
    destinationString[0] = stringLength;
}

// ***** doConcatPStrings

void doConcatPStrings(Str255 targetString,Str255 appendString)
{
    SInt16 appendLength;

    appendLength = MIN(appendString[0],255 - targetString[0]);

    if(appendLength > 0)
    {
        BlockMoveData(appendString+1,targetString+targetString[0]+1,(SInt32) appendLength);
        targetString[0] += appendLength;
    }
}

// ***** doTouchWindow

void doTouchWindow(void)
{
    WindowRef          windowRef;
    docStructureHandle docStrucHdl;

```

```

windowRef = FrontWindow();
docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

SetPortWindowPort(windowRef);

TextSize(48);
MoveTo(30,170);
DrawString("\pWINDOW TOUCHED");
TextSize(12);

(*docStrucHdl)->windowTouched = true;

SetWindowModified(windowRef,true);
}

// ***** openAppEventHandler
OSErr openAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,SInt32 handlerRefCon)
{
    OSErr osError;

    osError = doHasGotRequiredParams(appEvent);
    if(osError == noErr)
        osError = doNewCommand();

    return osError;
}

// ***** reopenAppEventHandler
OSErr reopenAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,
                           SInt32 handlerRefCon)
{
    OSErr osError;

    osError = doHasGotRequiredParams(appEvent);
    if(osError == noErr)
        if(!FrontWindow())
            osError = doNewCommand();

    return osError;
}

// ***** openAndPrintDocsEventHandler
OSErr openAndPrintDocsEventHandler(AppleEvent *appEvent,AppleEvent *reply,
                                   SInt32 handlerRefcon)
{
    FSSpec    fileSpec;
    AEDescList docList;
    OSErr      osError, ignoreErr;
    SInt32     index, numberOfItems;
    Size       actualSize;
    AEKeyword  keyword;
    DescType   returnedType;
    FInfo      fileInfo;

```

```

osError = AEGetParamDesc(appEvent, keyDirectObject, typeAEList, &docList);

if(osError == noErr)
{
    osError = doHasGotRequiredParams(appEvent);
    if(osError == noErr)
    {
        osError = AECCountItems(&docList, &numberOfItems);
        if(osError == noErr)
        {
            for(index=1; index<=numberOfItems; index++)
            {
                osError = AEGetNthPtr(&docList, index, typeFSS, &keyWord, &returnedType,
                                     &fileSpec, sizeof(fileSpec), &actualSize);
                if(osError == noErr)
                {
                    osError = FSpGetFInfo(&fileSpec, &fileInfo);
                    if(osError == noErr)
                    {
                        if(osError = doOpenFile(fileSpec, fileInfo.fdType))
                            doErrorAlert(osError);

                        if(osError == noErr && handlerRefcon == kPrint)
                        {
                            // Call printing function here
                        }
                    }
                }
            }
            else
                doErrorAlert(osError);
        }
    }
    else
        doErrorAlert(osError);

    ignoreErr = AEDisposeDesc(&docList);
}
else
    doErrorAlert(osError);

return osError;
}

// ***** quitAppEventHandler ***** quitAppEventHandler

OSErr quitAppEventHandler(AppleEvent *appEvent, AppleEvent *reply, SInt32 handlerRefcon)
{
    OSErr          osError;
    WindowRef      windowRef, previousWindowRef;
    docStructureHandle docStrucHdl;
    SInt16          touchedWindowsCount = 0;
    EventRef        eventRef;
    EventTargetRef  eventTargetRef;
    SInt16          itemHit;

```



```

osError = doHasGotRequiredParams(appEvent);
if(osError == noErr)
{
    if(FrontWindow())
    {
        // ..... if any window has a sheet, bring to front, play system alert sound, and return

        windowRef = GetFrontWindowOfClass(kSheetWindowClass,true);
        if(windowRef)
        {
            SelectWindow(windowRef);
            SysBeep(10);
            return noErr;
        }

        // ..... count touched windows

        windowRef = FrontWindow();
        do
        {
            docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
            if((*docStrucHdl)->windowTouched == true)
                touchedWindowsCount++;
            previousWindowRef = windowRef;
        } while(windowRef = GetNextWindowOfClass(previousWindowRef,kDocumentWindowClass,true));

        // ..... if no touched windows, simply close down

        if(touchedWindowsCount == 0)
            QuitApplicationEventLoop();

        // ..... if touched windows are present, and if running on OS X

        if(gRunningOnX)
        {
            // ..... if one touched window, cause Save Changes alert on that window, close all others

            if(touchedWindowsCount == 1)
            {
                gQuittingApplication = true;
                CreateEvent(NULL,kEventClassWindow,kEventWindowClose,0,kEventAttributeNone,
                    &eventRef);
                eventTargetRef = GetWindowEventTarget(FrontWindow());
                SendEventToEventTarget(eventRef,eventTargetRef);
            }

            // ..... if more than one touched window, create Review Changes alert, handle button clicks

            else if(touchedWindowsCount > 1)
            {
                itemHit = doReviewChangesAlert(touchedWindowsCount);
            }
        }
    }
}

```

```

        if(itemHit == kAlertStdAlertOKButton)
        {
            gQuittingApplication = true;
            CreateEvent(NULL,kEventClassWindow,kEventWindowClose,0,kEventAttributeNone,
                        &eventRef);
            eventTargetRef = GetWindowEventTarget(FrontWindow());
            SendEventToEventTarget(eventRef,eventTargetRef);
        }
        else if(itemHit == kAlertStdAlertCancelButton)
            gQuittingApplication = false;
        else if(itemHit == kAlertStdAlertOtherButton)
            QuitApplicationEventLoop();
    }
}

// ..... if touched windows are present, and if running on OS 8/9

else
{
    gQuittingApplication = true;
    CreateEvent(NULL,kEventClassWindow,kEventWindowClose,0,kEventAttributeNone,
                &eventRef);
    eventTargetRef = GetWindowEventTarget(FrontWindow());
    SendEventToEventTarget(eventRef,eventTargetRef);
}
else
    QuitApplicationEventLoop();
}

return osError;
}

// ***** doHasGotRequiredParams

OSErr doHasGotRequiredParams(AppleEvent *appEvent)
{
    DescType returnedType;
    Size      actualSize;
    OSErr      osError;

    osError = AEGetAttributePtr(appEvent,keyMissedKeywordAttr,typeWildCard,&returnedType,
                                NULL,0,&actualSize);
    if(osError == errAEDescNotFound)
        osError = noErr;
    else if(osError == noErr)
        osError = errAEParamMissed;

    return osError;
}

// ***** doReviewChangesAlert

```

```

SInt16 doReviewChangesAlert(SInt16 touchedWindowsCount)
{
    AlertStdCFStringAlertParamRec paramRec;
    Str255      messageText1 = "\pYou have ";
    Str255      messageText2 = "\p Files documents with unsaved changes. ";
    Str255      messageText3 = "\pDo you want to review these changes before quitting?";
    Str255      countString;
    CFStringRef messageText;
    CFStringRef informativeText =
        CFSTR("If you don't review your documents, all your changes will be lost.");
    DialogRef    dialogRef;
    DialogItemIndex itemHit;

    NumToString(touchedWindowsCount, countString);
    doConcatPStrings(messageText1, countString);
    doConcatPStrings(messageText1, messageText2);
    doConcatPStrings(messageText1, messageText3);
    messageText = CFStringCreateWithPascalString(NULL, messageText1, CFStringGetSystemEncoding());

    GetStandardAlertDefaultParams(&paramRec, kStdCFStringAlertVersionOne);
    paramRec.movable      = true;
    paramRec.defaultText  = CFSTR("Review Changes...");
    paramRec.cancelText   = CFSTR("Cancel");
    paramRec.otherText    = CFSTR("Discard Changes");

    CreateStandardAlert(kAlertStopAlert, messageText, informativeText, &paramRec, &dialogRef);
    RunStandardAlert(dialogRef, NULL, &itemHit);

    if(messageText != NULL)
        CFRelease(messageText);

    return itemHit;
}

// *****
// NewOpenCloseSave.c
// *****

// ..... includes

#include "Files.h"

// ..... global variables

NavDialogRef gModalToApplicationNavDialogRef;
SInt16      gCurrentNumberOfWindows = 0;
Rect        gDestRect, gViewRect;
Boolean     gCloseDocWindow = false;

extern NavEventUPP gGetFilePutFileEventFunctionUPP;
extern SInt16      gAppResFileRefNum;
extern Boolean     gQuittingApplication;
extern Boolean     gRunningOnX;

```

```

// ***** doNewCommand

OSErr doNewCommand(void)
{
    WindowRef windowRef;
    OSErr    osError;
    OSType    documentType = kFileTypeTEXT;

    osError = doNewDocWindow(true,documentType,&windowRef);

    if(osError == noErr)
        SetWindowProxyCreatorAndType(windowRef,kFileCreator,documentType,kUserDomain);    ////

    return osError;
}

// ***** doOpenCommand

OSErr doOpenCommand(void)
{
    OSErr                osError = noErr;
    NavDialogCreationOptions dialogOptions;
    Str255                applicationName;
    NavTypeListHandle     fileTypeListHdl = NULL;

    // ..... create application-modal Open dialog

    osError = NavGetDefaultDialogCreationOptions(&dialogOptions);
    if(osError == noErr)
    {
        GetIndString(applicationName,rMiscStrings,sApplicationName);
        dialogOptions.clientName = CFStringCreateWithPascalString(NULL,applicationName,
                                                                    CFStringGetSystemEncoding());

        dialogOptions.modality = kWindowModalityAppModal;
        fileTypeListHdl = (NavTypeListHandle) GetResource('open',rOpenResource);

        osError = NavCreateGetFileDialog(&dialogOptions,fileTypeListHdl,
                                         gGetFilePutFileEventFunctionUPP,NULL,NULL,NULL,
                                         &gModalToApplicationNavDialogRef);
        if(osError == noErr && gModalToApplicationNavDialogRef != NULL)
        {
            osError = NavDialogRun(gModalToApplicationNavDialogRef);
            if(osError != noErr)
            {
                NavDialogDispose(gModalToApplicationNavDialogRef);
                gModalToApplicationNavDialogRef = NULL;
            }
        }

        if(dialogOptions.clientName != NULL)
            CFRelease(dialogOptions.clientName);

        if(fileTypeListHdl != NULL)
            ReleaseResource((Handle) fileTypeListHdl);
    }
}

```

```

    return osError;
}

// ***** doCloseCommand

OSErr doCloseCommand(NavAskSaveChangesAction action)
{
    WindowRef      windowRef;
    SInt16          windowKind;
    docStructureHandle docStrucHdl;
    OSErr           osError = noErr;

    windowRef = FrontWindow();
    windowKind = GetWindowKind(windowRef);

    switch(windowKind)
    {
        case kApplicationWindowKind:
            docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

            // ..... if window has unsaved changes, create Save Changes alert

            if((*docStrucHdl)->windowTouched == true)
            {
                if(IsWindowCollapsed(windowRef))
                    CollapseWindow(windowRef,false);

                osError = doCreateAskSaveChangesDialog(windowRef,docStrucHdl,action);
            }

            // ..... otherwise close file and clean up

            else
                osError = doCloseDocWindow(windowRef);
            break;

        case kDialogWindowKind:
            // Hide or close modeless dialog, as required.
            break;
    }

    return osError;
}

// ***** doSaveCommand

OSErr doSaveCommand(void)
{
    WindowRef      windowRef;
    docStructureHandle docStrucHdl;
    OSErr           osError = noErr;
    Rect            portRect;

    windowRef = FrontWindow();
    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

```

```

// ..... if the document has a file ref number, write the file, otherwise call doSaveAsCommand

if((*docStrucHdl)->fileRefNum)
{
    osError = doWriteFile(windowRef);

    SetPortWindowPort(windowRef);
    GetWindowPortBounds(windowRef,&portRect);
    EraseRect(&portRect);
    InvalWindowRect(windowRef,&portRect);
}
else
    osError = doSaveAsCommand();

if(osError == noErr)                                     /////
    SetWindowModified(windowRef,false);                  /////

return osError;
}

// ***** doSaveAsCommand

OSErr doSaveAsCommand(void)
{
    OSErr          osError = noErr;
    NavDialogCreationOptions dialogOptions;
    WindowRef      windowRef;
    Str255          windowTitle, applicationName;
    docStructureHandle docStrucHdl;
    OSType          fileType;

    // ..... create window-modal Save Location dialog

    osError = NavGetDefaultDialogCreationOptions(&dialogOptions);
    if(osError == noErr)
    {
        dialogOptions.optionFlags |= kNavNoTypePopup;

        windowRef = FrontWindow();

        GetWTitle(windowRef,windowTitle);
        dialogOptions.saveFileName = CFStringCreateWithPascalString(NULL,windowTitle,
                                                                    CFStringGetSystemEncoding());
        GetIndString(applicationName,rMiscStrings,sApplicationName);
        dialogOptions.clientName = CFStringCreateWithPascalString(NULL,applicationName,
                                                                    CFStringGetSystemEncoding());

        dialogOptions.parentWindow = windowRef;
        dialogOptions.modality = kWindowModalityWindowModal;

        docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
        if((*docStrucHdl)->editStrucHdl != NULL)
            fileType = kFileTypeTEXT;
        else if((*docStrucHdl)->pictureHdl != NULL)
            fileType = kFileTypePICT;
    }
}

```

```

HLock((Handle) docStrucHdl);

osError = NavCreatePutFileDialog(&dialogOptions, fileType, kFileCreator,
                                gGetFilePutFileEventFunctionUPP,
                                windowRef, &(*docStrucHdl)->modalToWindowNavDialogRef);
HUnlock((Handle) docStrucHdl);

if(osError == noErr && (*docStrucHdl)->modalToWindowNavDialogRef != NULL)
{
    osError = NavDialogRun((*docStrucHdl)->modalToWindowNavDialogRef);
    if(osError != noErr)
    {
        NavDialogDispose((*docStrucHdl)->modalToWindowNavDialogRef);
        (*docStrucHdl)->modalToWindowNavDialogRef = NULL;
    }
}

if(dialogOptions.saveFileName != NULL)
    CFRelease(dialogOptions.saveFileName);
if(dialogOptions.clientName != NULL)
    CFRelease(dialogOptions.clientName);
}

return osError;
}

// ***** doRevertCommand

OSErr doRevertCommand(void)
{
    OSErr          osError = noErr;
    NavDialogCreationOptions dialogOptions;
    WindowRef      windowRef;
    Str255          windowTitle;
    docStructureHandle docStrucHdl;

    // ..... create window-modal Discard Changes alert

    osError = NavGetDefaultDialogCreationOptions(&dialogOptions);
    if(osError == noErr)
    {
        windowRef = FrontWindow();

        GetWTitle(windowRef, windowTitle);
        dialogOptions.saveFileName = CFStringCreateWithPascalString(NULL, windowTitle,
                                                                    CFStringGetSystemEncoding());
        dialogOptions.parentWindow = windowRef;
        dialogOptions.modality = kWindowModalityWindowModal;

        docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
        if((*docStrucHdl)->askSaveDiscardEventFunctionUPP != NULL)
        {
            DisposeNavEventUPP((*docStrucHdl)->askSaveDiscardEventFunctionUPP);
            (*docStrucHdl)->askSaveDiscardEventFunctionUPP = NULL;
        }
    }
}

```



```

    (*docStrucHdl)->askSaveDiscardEventFunctionUPP =
        NewNavEventUPP((NavEventProcPtr) askSaveDiscardEventFunction);

    HLock((Handle) docStrucHdl);

    osError = NavCreateAskDiscardChangesDialog(&dialogOptions,
                                              (*docStrucHdl)->askSaveDiscardEventFunctionUPP,
                                              windowRef,
                                              &(*docStrucHdl)->modalToWindowNavDialogRef);

    HUnlock((Handle) docStrucHdl);

    if(osError == noErr && (*docStrucHdl)->modalToWindowNavDialogRef != NULL)
    {
        osError = NavDialogRun((*docStrucHdl)->modalToWindowNavDialogRef);
        if(osError != noErr)
        {
            NavDialogDispose((*docStrucHdl)->modalToWindowNavDialogRef);
            (*docStrucHdl)->modalToWindowNavDialogRef = NULL;
        }
    }

    if(dialogOptions.saveFileName != NULL)
        CFRelease(dialogOptions.saveFileName);
}

return osError;
}

// ***** doNewDocWindow

OSErr doNewDocWindow(Boolean showWindow, OSType documentType, WindowRef * windowRef)
{
    OSStatus      osError;
    WindowAttributes  attributes = kWindowStandardHandlerAttribute |
                                   kWindowStandardDocumentAttributes;
    Rect          portRect, contentRect = { 0,0,300,500 };
    docStructureHandle docStrucHdl;
    EventTypeSpec  windowEvents[] = { { kEventClassWindow, kEventWindowDrawContent },
                                       { kEventClassWindow, kEventWindowClose },
                                       { kEventClassWindow, kEventWindowClickDragRgn },
                                       { kEventClassWindow, kEventWindowPathSelect } };

    if(gCurrentNumberOfWindows == kMaxWindows)
        return eMaxWindows;

    // ..... create window, change attributes, reposition, install event handler

    osError = CreateNewWindow(kDocumentWindowClass, attributes, &contentRect, windowRef);
    if(osError != noErr)
        return osError;

    SetWTitle(*windowRef, "\puntitled");
    ChangeWindowAttributes(*windowRef, 0, kWindowFullZoomAttribute | kWindowResizableAttribute);
    RepositionWindow(*windowRef, NULL, kWindowCascadeOnMainScreen);
    SetPortWindowPort(*windowRef);

```

```

InstallWindowEventHandler(*windowRef, doGetHandlerUPP(), GetEventTypeCount(windowEvents),
                        windowEvents, 0, NULL);

// ..... attach document structure to window

if(!(docStrucHdl = (docStructureHandle) NewHandle(sizeof(docStructure))))
{
    DisposeWindow(*windowRef);
    return MemError();
}

SetWRefCon(*windowRef, (SInt32) docStrucHdl);

(*docStrucHdl)->editStrucHdl          = NULL;
(*docStrucHdl)->pictureHdl            = NULL;
(*docStrucHdl)->fileRefNum            = 0;
(*docStrucHdl)->aliasHdl              = NULL;          ////
(*docStrucHdl)->windowTouched         = false;
(*docStrucHdl)->modalToWindowNavDialogRef = NULL;
(*docStrucHdl)->askSaveDiscardEventFunctionUPP = NULL;
(*docStrucHdl)->isAskSaveChangesDialog = false;

// ..... if text document, create TextEdit structure

if(documentType == kFileTypeTEXT)
{
    UseThemeFont(kThemeSmallSystemFont, smSystemScript);

    GetWindowPortBounds(*windowRef, &portRect);
    gDestRect = portRect;
    InsetRect(&gDestRect, 6, 6);
    gViewRect = gDestRect;

    MoveHHI((Handle) docStrucHdl);
    HLock((Handle) docStrucHdl);

    if(!((*docStrucHdl)->editStrucHdl = TENew(&gDestRect, &gViewRect)))
    {
        DisposeWindow(*windowRef);
        DisposeHandle((Handle) docStrucHdl);
        return MemError();
    }

    HUnlock((Handle) docStrucHdl);
}

// ..... show window and increment open windows count

if(showWindow)
    ShowWindow(*windowRef);

gCurrentNumberOfWindows++;

return noErr;
}

```

```

// ***** doGetHandlerUPP

EventHandlerUPP doGetHandlerUPP(void)
{
    static EventHandlerUPP windowEventHandlerUPP;

    if(windowEventHandlerUPP == NULL)
        windowEventHandlerUPP = NewEventHandlerUPP((EventHandlerProcPtr) windowEventHandler);

    return windowEventHandlerUPP;
}

// ***** doCloseDocWindow

OSErr doCloseDocWindow(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    OSErr              osError = noErr;
    EventRef           eventRef;
    EventTargetRef     eventTargetRef;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

    // ..... close file, flush volume, dispose of window and associated memory

    if((*docStrucHdl)->fileRefNum != 0)
    {
        if(!(osError = FSClose((*docStrucHdl)->fileRefNum)))
        {
            osError = FlushVol(NULL, (*docStrucHdl)->fileFSSpec.vRefNum);
            (*docStrucHdl)->fileRefNum = 0;
        }
    }

    if((*docStrucHdl)->editStrucHdl != NULL)
        TEDispose((*docStrucHdl)->editStrucHdl);
    if((*docStrucHdl)->pictureHdl != NULL)
        KillPicture((*docStrucHdl)->pictureHdl);

    DisposeHandle((Handle) docStrucHdl);
    DisposeWindow(windowRef);

    gCurrentNumberOfWindows --;

    // ..... if quitting application

    if(gQuittingApplication)
    {
        if(FrontWindow() == NULL)
            QuitApplicationEventLoop();
        else

```

```

    {
        CreateEvent(NULL, kEventClassWindow, kEventWindowClose, 0, kEventAttributeNone,
                    &eventRef);
        eventTargetRef = GetWindowEventTarget(FrontWindow());
        SendEventToEventTarget(eventRef, eventTargetRef);
    }
}

return osError;
}

// ***** doOpenFile

OSErr doOpenFile(FSSpec fileSpec, OSType documentType)
{
    WindowRef      windowRef;
    OSErr          osError = noErr;
    SInt16         fileRefNum;
    docStructureHandle docStrucHdl;

    // ..... create new window

    if(osError = doNewDocWindow(false, documentType, &windowRef))
        return osError;

    SetWTitle(windowRef, fileSpec.name);

    // ..... open file's data fork

    if(osError = FSpOpenDF(&fileSpec, fsRdWrPerm, &fileRefNum))
    {
        DisposeWindow(windowRef);
        gCurrentNumberOfWindows--;
        return osError;
    }

    // ..... store file reference number and FSSpec in window's document structure

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    (*docStrucHdl)->fileRefNum = fileRefNum;
    (*docStrucHdl)->fileFSSpec = fileSpec;

    // ..... read in the file

    if(documentType == kFileTypeTEXT)
    {
        if(osError = doReadTextFile(windowRef))
            return osError;
    }
    else if(documentType == kFileTypePICT)
    {
        if(osError = doReadPictFile(windowRef))
            return osError;
    }
}

```

```

// ..... set up window's proxy icon, and show window

SetWindowProxyFSSpec(windowRef,&fileSpec);                                     /////
GetWindowProxyAlias(windowRef,&((*docStrucHdl)->aliasHdl));                     /////
SetWindowModified(windowRef,false);                                           /////

ShowWindow(windowRef);

return noErr;
}

// ***** doCreateAskSaveChangesDialog

OSErr doCreateAskSaveChangesDialog(WindowRef windowRef,docStructureHandle docStrucHdl,
                                   NavAskSaveChangesAction action)
{
    OSErr          osError = noErr;
    NavDialogCreationOptions dialogOptions;
    Str255          windowTitle, applicationName;

    // ..... create window-modal Save Changes dialog

    osError = NavGetDefaultDialogCreationOptions(&dialogOptions);
    if(osError == noErr)
    {
        GetWTitle(windowRef,windowTitle);
        dialogOptions.saveFileName = CFStringCreateWithPascalString(NULL,windowTitle,
                                                                    CFStringGetSystemEncoding());

        GetIndString(applicationName,rMiscStrings,sApplicationName);
        dialogOptions.clientName = CFStringCreateWithPascalString(NULL,applicationName,
                                                                    CFStringGetSystemEncoding());

        dialogOptions.parentWindow = windowRef;
        dialogOptions.modality = kWindowModalityWindowModal;

        if((*docStrucHdl)->askSaveDiscardEventFunctionUPP != NULL)
        {
            DisposeNavEventUPP((*docStrucHdl)->askSaveDiscardEventFunctionUPP);
            (*docStrucHdl)->askSaveDiscardEventFunctionUPP = NULL;
        }
        (*docStrucHdl)->askSaveDiscardEventFunctionUPP =
            NewNavEventUPP((NavEventProcPtr) askSaveDiscardEventFunction);

        HLock((Handle) docStrucHdl);

        osError = NavCreateAskSaveChangesDialog(&dialogOptions,action,
                                                (*docStrucHdl)->askSaveDiscardEventFunctionUPP,
                                                windowRef,
                                                &(*docStrucHdl)->modalToWindowNavDialogRef);

        HUnlock((Handle) docStrucHdl);

        if(osError == noErr && (*docStrucHdl)->modalToWindowNavDialogRef != NULL)
        {
            (*docStrucHdl)->isAskSaveChangesDialog = true;

```

```

osError = NavDialogRun((*docStrucHdl)->modalToWindowNavDialogRef);
if(osError != noErr)
{
    NavDialogDispose((*docStrucHdl)->modalToWindowNavDialogRef);
    (*docStrucHdl)->modalToWindowNavDialogRef = NULL;
    (*docStrucHdl)->isAskSaveChangesDialog = false;
}

if(!gRunningOnX)
{
    if(gCloseDocWindow)
    {
        osError = doCloseDocWindow(windowRef);
        if(osError != noErr)
            doErrorAlert(osError);
        gCloseDocWindow = false;
    }
}

if(dialogOptions.saveFileName != NULL)
    CFRelease(dialogOptions.saveFileName);
if(dialogOptions.clientName != NULL)
    CFRelease(dialogOptions.clientName);
}

return osError;
}

// ***** doSaveUsingFSSpec

OSErr doSaveUsingFSSpec(WindowRef windowRef, NavReplyRecord *navReplyStruc)
{
    OSErr          osError = noErr;
    AEKeyword      theKeyword;
    DescType       actualType;
    FSSpec         fileSpec;
    Size           actualSize;
    docStructureHandle docStrucHdl;
    OSType         fileType;
    CFStringRef     fileName;
    SInt16         fileRefNum;
    Rect           portRect;

    if((*navReplyStruc).validRecord)
    {
        // ..... get FSSpec

        if((osError = AEGetNthPtr(&(*navReplyStruc).selection, 1, typeFSS, &theKeyword,
                                &actualType, &fileSpec, sizeof(fileSpec), &actualSize)) == noErr)
        {
            docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

```

```

// ..... get file name, convert to Pascal string, assign to name field of FSSpec

fileName = NavDialogGetSaveFileName((*docStrucHdl)->modalToWindowNavDialogRef);
if(fileName != NULL)
    osError = CFStringGetPascalString(fileName,&fileSpec.name[0],sizeof(FSSpec),
                                      CFStringGetSystemEncoding());

// ..... if not replacing, first create a new file

if(!((*navReplyStruc).replacing))
{
    if((*docStrucHdl)->editStrucHdl != NULL)
        fileType = kFileTypeTEXT;
    else if((*docStrucHdl)->pictureHdl != NULL)
        fileType = kFileTypePICT;

    osError = FSpCreate(&fileSpec,kFileCreator,fileType,(*navReplyStruc).keyScript);
    if(osError != noErr)
    {
        NavDisposeReply(&(*navReplyStruc));
        return osError;
    }
}

// ..... assign FSSpec to fileFSSpec field of window's document structure

(*docStrucHdl)->fileFSSpec = fileSpec;

// ..... if file currently exists for document, close it

if((*docStrucHdl)->fileRefNum != 0)
{
    osError = FSClose((*docStrucHdl)->fileRefNum);
    (*docStrucHdl)->fileRefNum = 0;
}

// ..... open file's data fork and write file

if(osError == noErr)
    osError = FSpOpenDF(&(*docStrucHdl)->fileFSSpec,fsRdWrPerm,&fileRefNum);

if(osError == noErr)
{
    (*docStrucHdl)->fileRefNum = fileRefNum;
    SetWTitle(windowRef,fileSpec.name);

    // ..... proxy icon and file synchronisation stuff

    SetPortWindowPort(windowRef);
    SetWindowProxyFSSpec(windowRef,&fileSpec);
    GetWindowProxyAlias(windowRef,&((*docStrucHdl)->aliasHdl));
    SetWindowModified(windowRef,false);
}

```



```

    // ..... write file using safe save

    osError = doWriteFile(windowRef);

    NavCompleteSave(&(*navReplyStruc),kNavTranslateInPlace);
}
}
}

SetPortWindowPort(windowRef);
GetWindowPortBounds(windowRef,&portRect);
EraseRect(&portRect);
InvalWindowRect(windowRef,&portRect);

return osError;
}

// ***** doSaveUsingFSRef

OSErr doSaveUsingFSRef(WindowRef windowRef,NavReplyRecord *navReplyStruc)
{
    OSErr      osError = noErr;
    AEDesc      aeDesc;
    Size        dataSize;
    FSRef       fsRefParent, fsRefDelete;
    UniCharCount nameLength;
    UniChar     *nameBuffer;
    FSSpec       fileSpec;
    docStructureHandle docStrucHdl;
    FInfo        fileInfo;
    SInt16       fileRefNum;
    Rect         portRect;

    osError = AECoeerceDesc(&(*navReplyStruc).selection,typeFSRef,&aeDesc);
    if(osError == noErr)
    {
        // ..... get FSRef

        dataSize = AEGetDescDataSize(&aeDesc);
        if(dataSize > 0)
            osError = AEGetDescData(&aeDesc,&fsRefParent,sizeof(FSRef));
        if(osError == noErr)
        {
            // ..... get file name from saveFileName field of NavReplyRecord

            nameLength = (UniCharCount) CFStringGetLength((*navReplyStruc).saveFileName);
            nameBuffer = (UniChar *) NewPtr(nameLength);
            CFStringGetCharacters((*navReplyStruc).saveFileName,CFRangeMake(0,nameLength),
                                &nameBuffer[0]);

            if(nameBuffer != NULL)
            {

```

```

// ..... if replacing, delete the file being replaced

if((*navReplyStruc).replacing)
{
    osError = FSMakeFSRefUnicode(&fsRefParent,nameLength,nameBuffer,
                                kTextEncodingUnicodeDefault,&fsRefDelete);

    {
        if(osError == noErr)
            osError = FSDeleteObject(&fsRefDelete);
        if(osError == fBsyErr)
        {
            DisposePtr((Ptr) nameBuffer);
            return osError;
        }
    }
}

// ..... create file with Unicode name (but it can be written with an FSSpec)

if(osError == noErr)
{
    osError = FSCreateFileUnicode(&fsRefParent,nameLength,nameBuffer,kFSCatInfoNone,
                                NULL,NULL,&fileSpec);

    if(osError == noErr)
    {
        docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

        osError = FSpGetFInfo(&fileSpec,&fileInfo);

        if((*docStrucHdl)->editStrucHdl != NULL)
            fileInfo.fdType = kFileTypeTEXT;
        else if((*docStrucHdl)->pictureHdl != NULL)
            fileInfo.fdType = kFileTypePICT;
        fileInfo.fdCreator = kFileCreator;

        if(osError == noErr)
            osError = FSpSetFInfo(&fileSpec,&fileInfo);

        (*docStrucHdl)->fileFSSpec = fileSpec;

        // ..... open file's data fork and write file

        if(osError == noErr)
            osError = FSpOpenDF(&fileSpec,fsRdWrPerm,&fileRefNum);

        if(osError == noErr)
        {
            (*docStrucHdl)->fileRefNum = fileRefNum;
            SetWTitle(windowRef,fileSpec.name);
        }
    }
}

```

```

// ... .. proxy icon and file synchronisation stuff

SetPortWindowPort(windowRef);
SetWindowProxyFSSpec(windowRef,&fileSpec);
GetWindowProxyAlias(windowRef,&((*docStrucHdl)->aliasHdl));
SetWindowModified(windowRef,false);

// ... .. write file using safe save

osError = doWriteFile(windowRef);

NavCompleteSave(&(*navReplyStruc),kNavTranslateInPlace);
}
}
}

DisposePtr((Ptr) nameBuffer);
}

AEDisposeDesc(&aeDesc);
}

SetPortWindowPort(windowRef);
GetWindowPortBounds(windowRef,&portRect);
EraseRect(&portRect);
InvalWindowRect(windowRef,&portRect);

return osError;
}

// ***** doWriteFile

OSErr doWriteFile(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    FSSpec             fileSpecActual, fileSpecTemp;
    UInt32             currentTime;
    Str255             tempFileName;
    SInt16             tempFileVolNum, tempFileRefNum;
    SInt32             tempFileDirID;
    OSErr              osError = noErr;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    fileSpecActual = (*docStrucHdl)->fileFSSpec;

    GetDateTime(&currentTime);
    NumToString((SInt32) currentTime,tempFileName);

    osError = FindFolder(fileSpecActual.vRefNum,kTemporaryFolderType,kCreateFolder,
                        &tempFileVolNum,&tempFileDirID);

    if(osError == noErr)
        osError = FSMakeFSSpec(tempFileVolNum,tempFileDirID,tempFileName,&fileSpecTemp);

```

```

if(osError == noErr || osError == fnfErr)
    osError = FSpCreate(&fileSpecTemp, 'trsh', 'trsh', smSystemScript);
if(osError == noErr)
    osError = FSpOpenDF(&fileSpecTemp, fsRdWrPerm, &tempFileRefNum);
if(osError == noErr)
{
    if((*docStrucHdl)->editStrucHdl)
        osError = doWriteTextData(windowRef, tempFileRefNum);
    else if((*docStrucHdl)->pictureHdl)
        osError = doWritePictData(windowRef, tempFileRefNum);
}
if(osError == noErr)
    osError = FSClose(tempFileRefNum);
if(osError == noErr)
    osError = FSClose((*docStrucHdl)->fileRefNum);
if(osError == noErr)
    osError = FSpExchangeFiles(&fileSpecTemp, &fileSpecActual);
if(osError == noErr)
    osError = FSpDelete(&fileSpecTemp);
if(osError == noErr)
    osError = FSpOpenDF(&fileSpecActual, fsRdWrPerm, &(*docStrucHdl)->fileRefNum);

if(osError == noErr)
    osError = doCopyResources(windowRef);

return osError;
}

// ***** doReadTextFile

OSErr doReadTextFile(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    SInt16              fileRefNum;
    TEHandle            textEditHdl;
    SInt32              numberOfBytes;
    Handle              textBuffer;
    OSErr               osError = noErr;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    fileRefNum = (*docStrucHdl)->fileRefNum;

    textEditHdl = (*docStrucHdl)->editStrucHdl;
    (*textEditHdl)->txSize = 10;
    (*textEditHdl)->lineHeight = 15;

    SetFPos(fileRefNum, fsFromStart, 0);
    GetEOF(fileRefNum, &numberOfBytes);

    if(numberOfBytes > 32767)
        numberOfBytes = 32767;

    if(!(textBuffer = NewHandle((Size) numberOfBytes)))
        return MemError();
}

```

```

osError = FSRead(fileRefNum,&numberOfBytes,*textBuffer);
if(osError == noErr || osError == eofErr)
{
    HLockHi(textBuffer);
    TESSetText(*textBuffer,numberOfBytes,(*docStrucHdl)->editStrucHdl);
    HUnlock(textBuffer);
    DisposeHandle(textBuffer);
}
else
    return osError;

return noErr;
}

// ***** doReadPictFile

OSErr doReadPictFile(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    SInt16      fileRefNum;
    SInt32      numberOfBytes;
    OSErr      osError = noErr;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    fileRefNum = (*docStrucHdl)->fileRefNum;

    GetEOF(fileRefNum,&numberOfBytes);
    SetFPos(fileRefNum,fsFromStart,512);
    numberOfBytes -= 512;

    if(!((*docStrucHdl)->pictureHdl = (PicHandle) NewHandle(numberOfBytes)))
        return MemError();

    osError = FSRead(fileRefNum,&numberOfBytes,(*docStrucHdl)->pictureHdl);
    if(osError == noErr || osError == eofErr)
        return(noErr);
    else
        return osError;
}

// ***** doWriteTextData

OSErr doWriteTextData(WindowRef windowRef,SInt16 tempFileRefNum)
{
    docStructureHandle docStrucHdl;
    TEHandle          textEditHdl;
    Handle            editText;
    SInt32            numberOfBytes;
    SInt16            volRefNum;
    OSErr            osError = noErr;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    textEditHdl = (*docStrucHdl)->editStrucHdl;
    editText = (*textEditHdl)->hText;
    numberOfBytes = (*textEditHdl)->teLength;

```

```

osError = SetFPos(tempFileRefNum,fsFromStart,0);
if(osError == noErr)
    osError = FWrite(tempFileRefNum,&numberOfBytes,*editText);
if(osError == noErr)
    osError = SetEOF(tempFileRefNum,numberOfBytes);
if(osError == noErr)
    osError = GetVRefNum(tempFileRefNum,&volRefNum);
if(osError == noErr)
    osError = FlushVol(NULL,volRefNum);

if(osError == noErr)
    (*docStrucHdl)->windowTouched = false;

return osError;
}

// ***** doWritePictData

OSErr doWritePictData(WindowRef windowRef,SInt16 tempFileRefNum)
{
    docStructureHandle docStrucHdl;
    PicHandle          pictureHdl;
    SInt32              numberOfBytes, dummyData;
    SInt16              volRefNum;
    OSErr               osError = noErr;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    pictureHdl = (*docStrucHdl)->pictureHdl;

    numberOfBytes = 512;
    dummyData = 0;

    osError = SetFPos(tempFileRefNum,fsFromStart,0);

    if(osError == noErr)
        osError = FWrite(tempFileRefNum,&numberOfBytes,&dummyData);

    numberOfBytes = GetHandleSize((Handle) (*docStrucHdl)->pictureHdl);

    if(osError == noErr)
    {
        HLock((Handle) (*docStrucHdl)->pictureHdl);
        osError = FWrite(tempFileRefNum,&numberOfBytes,*(docStrucHdl)->pictureHdl);
        HUnlock((Handle) (*docStrucHdl)->pictureHdl);
    }

    if(osError == noErr)
        osError = SetEOF(tempFileRefNum,512 + numberOfBytes);
    if(osError == noErr)
        osError = GetVRefNum(tempFileRefNum,&volRefNum);
    if(osError == noErr)
        osError = FlushVol(NULL,volRefNum);
}

```

```

if(osError == noErr)
    (*docStrucHdl)->windowTouched = false;

return osError;
}

// ***** getFilePutFileEventFunction

void getFilePutFileEventFunction(NavEventCallbackMessage callBackSelector,
                                NavCBRecPtr callBackParms,NavCallBackUserData callBackUD)
{
    OSErr                osError = noErr;
    NavReplyRecord        navReplyStruc;
    NavUserAction         navUserAction;
    SInt32                count, index;
    AEKeyword             theKeyword;
    DescType              actualType;
    FSSpec                fileSpec;
    Size                  actualSize;
    FInfo                 fileInfo;
    OSType                documentType;
    WindowRef             windowRef;
    AEDesc                aeDesc;
    AEKeyword             keyWord;
    DescType              typeCode;
    Rect                  theRect;
    Str255                 theString, numberString;
    docStructureHandle     docStrucHdl;

    switch(callBackSelector)
    {
    case kNavCBUserAction:
        osError = NavDialogGetReply(callBackParms->context,&navReplyStruc);
        if(osError == noErr && navReplyStruc.validRecord)
        {
            navUserAction = NavDialogGetUserAction(callBackParms->context);

            switch(navUserAction)
            {
            // ..... click on Open button in Open dialog

            case kNavUserActionOpen:
                if(gModalToApplicationNavDialogRef != NULL)
                {
                    osError = AECountItems(&(navReplyStruc.selection),&count);
                    if(osError == noErr)
                    {
                        for(index=1;index<=count;index++)
                        {
                            osError = AEGetNthPtr(&(navReplyStruc.selection),index,typeFSS,
                                                    &theKeyword,&actualType,&fileSpec,sizeof(fileSpec),
                                                    &actualSize);
                        }
                    }
                }
            }
        }
    }
}

```



```

        if((osError = FSpGetFInfo(&fileSpec,&fileInfo)) == noErr)
        {
            documentType = fileInfo.fdType;
            osError = doOpenFile(fileSpec,documentType);
            if(osError != noErr)
                doErrorAlert(osError);
        }
    }
}
break;

// ..... click on Save button in Save Location dialog

case kNavUserActionSaveAs:
    windowRef = callBackUD;
    osError = AECoerceDesc(&navReplyStruc.selection,typeFSRef,&aeDesc);
    if(osError == noErr)
    {
        osError = doSaveUsingFSRef(windowRef,&navReplyStruc);
        if(osError != noErr)
            doErrorAlert(osError);
        AEDisposeDesc(&aeDesc);
    }
    else
    {
        osError = doSaveUsingFSSpec(windowRef,&navReplyStruc);
        if(osError != noErr)
            doErrorAlert(osError);
    }
    break;

// ..... click on Choose button in Choose a Folder dialog

case kNavUserActionChoose:
    if((osError = AEGetNthPtr(&(navReplyStruc.selection),1,typeFSS,&keyWord,&typeCode,
        &fileSpec,sizeof(FSSpec),&actualSize)) == noErr)
    {
        FSMakeFSSpec(fileSpec.vRefNum,fileSpec.parID,fileSpec.name,&fileSpec);
    }
    windowRef = callBackUD;
    SetPortWindowPort(windowRef);
    TextSize(10);
    SetRect(&theRect,0,271,600,300);
    EraseRect(&theRect);
    doCopyPString(fileSpec.name,theString);
    doConcatPStrings(theString, "\p Volume Reference Number: ");
    NumToString((SInt32) fileSpec.vRefNum,numberString);
    doConcatPStrings(theString,numberString);
    doConcatPStrings(theString, "\p Parent Directory ID: ");
    NumToString((SInt32) fileSpec.parID,numberString);
    doConcatPStrings(theString,numberString);
    MoveTo(10,290);
    DrawString(theString);
    break;
}

```

```

        osError = NavDisposeReply(&navReplyStruc);
    }
    break;

case kNavCBTerminate:
    if(gModalToApplicationNavDialogRef != NULL)
    {
        NavDialogDispose(gModalToApplicationNavDialogRef);
        gModalToApplicationNavDialogRef = NULL;
    }
    else
    {
        windowRef = callBackUD;
        docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
        if((*docStrucHdl)->modalToWindowNavDialogRef != NULL)
        {
            NavDialogDispose((*docStrucHdl)->modalToWindowNavDialogRef);
            (*docStrucHdl)->modalToWindowNavDialogRef = NULL;
        }
    }
    break;
}
}

// ***** askSaveDiscardEventFunction

void askSaveDiscardEventFunction(NavEventCallbackMessage callBackSelector,
                                NavCBRecPtr callBackParms,NavCallBackUserData callBackUD)
{
    WindowRef          windowRef;
    docStructureHandle docStrucHdl;
    NavUserAction       navUserAction;
    OSErr               osError = noErr;
    Rect               portRect;

    switch(callBackSelector)
    {
    case kNavCBUserAction:
        windowRef = callBackUD;
        docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

        if((*docStrucHdl)->modalToWindowNavDialogRef != NULL)
        {
            navUserAction = NavDialogGetUserAction(callBackParms->context);
            switch(navUserAction)
            {
                // ..... click on Save button in Save Changes alert

            case kNavUserActionSaveChanges:
                osError = doSaveCommand();
                if(osError != noErr)
                    doErrorAlert(osError);
            }
        }
    }
}

```

```

// ..... click on Don't Save button in Save Changes alert

case kNavUserActionDontSaveChanges:
    NavDialogDispose((*docStrucHdl)->modalToWindowNavDialogRef);
    if(gRunningOnX)
    {
        osError = doCloseDocWindow(windowRef);
        if(osError != noErr)
            doErrorAlert(osError);
    }
    else
        gCloseDocWindow = true;
    break;

// ..... click on OK button in Discard Changes alert

case kNavUserActionSaveChanges:
    osError = doSaveCommand();
    if(osError != noErr)
        doErrorAlert(osError);

// ..... click on Don't Save button in Save Changes alert

case kNavUserActionDontSaveChanges:
    NavDialogDispose((*docStrucHdl)->modalToWindowNavDialogRef);
    osError = doCloseDocWindow(windowRef);
    if(osError != noErr)
        doErrorAlert(osError);
    break;

// ..... click on OK button in Discard Changes alert

case kNavUserActionDiscardChanges:
    GetWindowPortBounds(windowRef,&portRect);
    SetPortWindowPort(windowRef);
    EraseRect(&portRect);

    if((*docStrucHdl)->editStrucHdl != NULL && (*docStrucHdl)->fileRefNum != 0)
    {
        osError = doReadTextFile(windowRef);
        if(osError != noErr)
            doErrorAlert(osError);
    }
    else if((*docStrucHdl)->pictureHdl != NULL)
    {
        KillPicture((*docStrucHdl)->pictureHdl);
        (*docStrucHdl)->pictureHdl = NULL;

        osError = doReadPictFile(windowRef);
        if(osError != noErr)
            doErrorAlert(osError);
    }
}

```

```

        (*docStrucHdl)->windowTouched = false;
        SetWindowModified(windowRef,false);
        InvalWindowRect(windowRef,&portRect);

        NavDialogDispose((*docStrucHdl)->modalToWindowNavDialogRef);
        (*docStrucHdl)->modalToWindowNavDialogRef = NULL;
        break;

// ..... click on Cancel button in Save Changes or Discard Changes alert

case kNavUserActionCancel:
    if((*docStrucHdl)->isAskSaveChangesDialog == true)
    {
        gQuittingApplication = false;
        (*docStrucHdl)->isAskSaveChangesDialog = false;
    }
    NavDialogDispose((*docStrucHdl)->modalToWindowNavDialogRef);
    (*docStrucHdl)->modalToWindowNavDialogRef = NULL;
    break;
}
}
break;
}
}

// ***** doCopyResources

OSErr doCopyResources(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    OSType              fileType;
    OSError              osError = noErr;
    SInt16              fileRefNum;
    Handle              editTextHdl, textResourceHdl;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

    if((*docStrucHdl)->editStrucHdl)
        fileType = kFileTypeTEXT;
    else if((*docStrucHdl)->pictureHdl)
        fileType = kFileTypePICT;

    FSpCreateResFile(&(*docStrucHdl)->fileFSSpec,kFileCreator,fileType,smSystemScript);

    osError = ResError();
    if(osError == noErr)
        fileRefNum = FSpOpenResFile(&(*docStrucHdl)->fileFSSpec,fsRdWrPerm);

    if(fileRefNum > 0)
    {
        osError = doCopyAResource('STR ', -16396,gAppResFileRefNum,fileRefNum);
    }
}

```

```

    if(fileType == kFileTypePICT)
    {
        doCopyAResource('pnot',128,gAppResFileRefNum,fileRefNum);
        doCopyAResource('PICT',128,gAppResFileRefNum,fileRefNum);
    }

    if(!gRunningOnX && fileType == kFileTypeTEXT)
    {
        doCopyAResource('pnot',129,gAppResFileRefNum,fileRefNum);

        editTextHdl = (*(docStrucHdl)->editStrucHdl)->hText;
        textResourceHdl = NewHandleClear(1024);
        BlockMoveData(*editTextHdl,*textResourceHdl,1024);
        UseResFile(fileRefNum);
        AddResource(textResourceHdl,'TEXT',129,"p");
        if(ResError() == noErr)
            UpdateResFile(fileRefNum);
        ReleaseResource(textResourceHdl);
    }
}
else
    osError = ResError();

if(osError == noErr)
    CloseResFile(fileRefNum);

osError = ResError();
return osError;
}

// ***** doCopyAResource

OSErr doCopyAResource(ResType resourceType,SInt16 resourceID,SInt16 sourceFileRefNum,
                    SInt16 destFileRefNum)
{
    Handle sourceResourceHdl;
    Str255 sourceResourceName;
    ResType ignoredType;
    SInt16 ignoredID;

    UseResFile(sourceFileRefNum);

    sourceResourceHdl = GetResource(resourceType,resourceID);

    if(sourceResourceHdl != NULL)
    {
        GetResInfo(sourceResourceHdl,&ignoredID,&ignoredType,sourceResourceName);
        DetachResource(sourceResourceHdl);
        UseResFile(destFileRefNum);
        AddResource(sourceResourceHdl,resourceType,resourceID,sourceResourceName);
        if(ResError() == noErr)
            UpdateResFile(destFileRefNum);
    }
}

```

```

    ReleaseResource(sourceResourceHdl);

    return ResError();
}

// *****
// SynchroniseFiles.c
// *****

// ..... includes

#include "Files.h"

// ..... global variables

extern SInt16 gCurrentNumberOfWindows;

// ***** doSynchroniseFiles

void doSynchroniseFiles(void)
{
    WindowRef      windowRef;
    SInt16          trashVRefNum;
    SInt32          trashDirID;
    docStructureHandle docStrucHdl;
    Boolean         aliasChanged;
    AliasHandle     aliasHdl;
    FSSpec          newFSSpec;
    OSErr           osError;

    windowRef = FrontNonFloatingWindow();

    while(windowRef != NULL)
    {
        docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

        if(docStrucHdl != NULL)
        {
            if((*docStrucHdl)->aliasHdl == NULL)
                break;

            aliasChanged = false;
            aliasHdl = (*docStrucHdl)->aliasHdl;
            ResolveAlias(NULL, aliasHdl, &newFSSpec, &aliasChanged);

            if(aliasChanged)
            {
                (*docStrucHdl)->fileFSSpec = newFSSpec;
                SetWTitle(windowRef, newFSSpec.name);
            }

            osError = FindFolder(kUserDomain, kTrashFolderType, kDontCreateFolder, &trashVRefNum,
                                &trashDirID);

```

```

        if(osError == noErr)
        {
            do
            {
                if(newFSSpec.parID == fsRtParID)
                    break;

                if((newFSSpec.vRefNum == trashVRefNum) && (newFSSpec.parID == trashDirID))
                {
                    FSClose((*docStrucHdl)->fileRefNum);
                    if((*docStrucHdl)->editStrucHdl)
                        TEDDispose((*docStrucHdl)->editStrucHdl);
                    if((*docStrucHdl)->pictureHdl)
                        KillPicture((*docStrucHdl)->pictureHdl);
                    DisposeHandle((Handle) docStrucHdl);
                    DisposeWindow(windowRef);
                    gCurrentNumberOfWindows --;
                    break;
                }
            } while(FSMakeFSSpec(newFSSpec.vRefNum,newFSSpec.parID,"\\p",&newFSSpec) == noErr);
        }
    }

    windowRef = GetNextWindow(windowRef);
}

// *****
// ChooseAFolderDialog.c
// *****

// ..... includes

#include "Files.h"

// ..... global variables

extern NavEventUPP gGetFilePutFileEventFunctionUPP ;
extern NavDialogRef gModalToApplicationNavDialogRef;

// ***** doChooseAFolderDialog

OSErr doChooseAFolderDialog(void)
{
    OSErr                osError = noErr;
    NavDialogCreationOptions dialogOptions;
    WindowRef            windowRef, parentWindowRef;
    Str255                message;

    osError = NavGetDefaultDialogCreationOptions(&dialogOptions);
    if(osError == noErr)
    {
        if((osError = GetSheetWindowParent(FrontWindow(),&parentWindowRef)) == noErr)
            windowRef = parentWindowRef;
        else
            windowRef = FrontWindow();
    }
}

```

```

GetIndString(message, rMiscStrings, sChooseAFolder);
dialogOptions.message = CFStringCreateWithPascalString(NULL, message,
                                                         CFStringGetSystemEncoding());
dialogOptions.modality = kWindowModalityAppModal;

osError = NavCreateChooseFolderDialog(&dialogOptions, gGetFilePutFileEventFunctionUPP ,
                                     NULL, windowRef, &gModalToApplicationNavDialogRef);

if (osError == noErr && gModalToApplicationNavDialogRef != NULL)
{
    osError = NavDialogRun(gModalToApplicationNavDialogRef);
    if (osError != noErr)
    {
        NavDialogDispose(gModalToApplicationNavDialogRef);
        gModalToApplicationNavDialogRef = NULL;
    }
}
}

return osError;
}

// *****

```

## Demonstration Program Files Comments

When the program is run, the user should:

- Exercise the File menu by opening the supplied TEXT and PICT files, saving those files, saving those files under new names, closing files, opening the new files, attempting to open files that are already open, attempting to save files to new files with existing names, making open windows “touched” by choosing the first item in the Demonstration menu, reverting to the saved versions of files associated with “touched” windows, choosing Quit when one “touched” window is open, choosing Quit when two or more “touched” windows are open, and so on.
- Choose, via the Show pop-up menu button, the file types required to be displayed in the Open dialog.
- Choose the Choose a Folder item from the Demonstration menu to display the Choose a Folder dialog, and choose a folder using the Choose button at the bottom of the dialog. (The name of the chosen folder will be drawn in the bottom-left corner of the front window.)
- With either the PICT Document or the TEXT Document open
  - With the document’s Finder icon visible, drag the window proxy icon to the desktop or to another open folder, noting that the Finder icon moves to the latter. Then choose Touch Window from the Demonstration menu to simulate unsaved changes



to the document. Note that the proxy icon changes to the disabled state. Then save the file, proving the correct operation of the file synchronization function. Note that, after the save, the window proxy icon changes back to the enabled state.

- Command-click the window's title to display the window path pop-up menu, choose a folder from the menu, and note that the Finder is brought to the foreground and the chosen folder opens.

The program may be run from within CodeWarrior to demonstrate responses to the File menu commands and the Choose a Folder dialog.

The built application, together with the supplied 'TEXT' and 'PICT' files, may be used to demonstrate the additional aspect of integrating the receipt of required Apple events with the overall file handling mechanism. To prove the correct handling of the required Apple events, the user should:

- Open the application by double-clicking the application icon, noting that a new document window is opened after the application is launched and the Open Application event is received.
- Double click on a document icon, or select one or more document icons and either drag those icons to the application icon or choose Open from the Finder's File menu, noting that the application is launched and the selected files are opened when the Open Documents event is received.
- Close all windows and double-click the application icon, noting that the application responds to the Re-open Application event by opening a new window.
- With the PICT Document and the TEXT Document open and "touched," and several other windows open, choose Restart or Shut Down from the Mac OS 8/9 Finder's Special menu or the Mac OS X Apple menu (thus invoking a Quit Application event), noting that, for "touched" windows, the Save Changes alert is presented asking the user whether the file should be saved before the shutdown process proceeds. (On Mac OS X, a Review Unsaved alert will be presented at first.)

Note, however, that no printing functions are included. Thus, selecting one or more document icons and choosing Print from the Finder's File menu (Mac OS 8/9) will result in the file opening but not printing.

## Files.h

### defines

Constants are established for a 'STR#' resource containing error strings for three specific error conditions, a 'STR#' resource containing the application's name and the message string for the Choose a Folder dialog, and the 'open' resource containing the file types list.

KFileCreator represents the application's signature and the next two constants represent the file types that are readable and writeable by the application.

## typedefs

Each window created by the program will have an associated document structure. The docStructure data type will be used for document structures.

The editStrucHdl field will be assigned a handle to a TextEdit structure ('TEXT' files). The pictureHdl field will be assigned a handle to a Picture structure ('PICT' files). The fileRefNum and fileFSSpec fields will be assigned the file reference number and the file system specification structure of the file associated with the window. When a file is opened, the aliasHdl field will be assigned a handle to a structure of type AliasRecord, which contains the alias data for the file. The windowTouched field will be set to true when a window has been made "touched."

When modal-to-the-window Navigation Services dialogs (Save Location, Save Changes, and Discard Changes alerts) are created, the dialog reference will be assigned to the modalToWindowNavDialogRef field. When Save Changes and Discard Changes alerts are created, a universal procedure pointer to the associated event (callback) function will be assigned to the askSaveDiscardChangesDialog field. When a Save Changes alert is created, the isAskSaveChangesDialog field will be set to true to enable the associated event (callback) function to reset a "quitting application" flag if the user clicks the Cancel button in a Save Changes alert (but not if the user clicks the Cancel button in a Discard Changes alert).

## Files.c

### Global Variables

gAppResFileRefNum will be assigned the file reference number of the application's resource fork. gGetFilePutFileEventFunctionUPP will be assigned a universal procedure pointer to the event (callback) function associated with the Open, Save Location, and Choose a Folder dialogs. gQuittingApplication is set to true in certain circumstances within quitAppEventHandler and to false if the Cancel button is clicked in a Save Changes or Review Unsaved alert.

### main

The file reference number of the application's resource fork (which is opened automatically at application launch) is assigned to the global variable gAppResFileRefNum.

After the required Apple event handlers are installed, the program's application event handler and a timer are installed. The timer is set to fire at an interval of 15 ticks, and will be used to trigger calls to the function doIdle, which calls the program's file synchronization function.

A universal procedure pointer to the event (callback) function associated with the Open, Save Location, and Choose a Folder dialogs is created and assigned to the global variable `gGetFilePutFileEventFunctionUPP`.

### **doInstallAEHandlers**

`doInstallAEHandlers` installs handlers for the Open Application, Re-Open Application, Open Document, Print Documents, and Quit Application events. Since the program installs its own Quit Application event handler, the default Quit Application event handler will not be installed when `RunApplicationEventLoop` is called.

### **windowEventHandler**

`windowEventHandler` is the program's window event handler (a callback function), which is installed on all document windows.

Note that, when the event type `kEventWindowClose` is received, the constant passed in the call to `doCloseCommand` depends on whether the global variable `gQuittingApplication` is set to true or false. This constant affects the text in the Save Changes alert.

Note also that no code is required in a Carbon application to handle window path pop-up menus. The standard window handler handles all user interaction with window path pop-up menus, including bringing the Finder to the front when the user chooses a folder.

### **doIdle**

`doIdle` is called when the installed timer fires. If the front window is a document window, `doSynchroniseFiles` is called to synchronize the application with the actual current location (and name) of its currently open document files.

### **doDrawContent**

`doDrawContent` is called when the `kEventWindowDrawContent` event type is received. It performs such window updating as is necessary for the satisfactory execution of the demonstration aspects of the program.

### **doMenuChoice**

At the `File_Close` case, `kNavSaveChangesClosingDocument` is passed in the call to `doCloseCommand`. This affects the wording in the Save Changes alert.

### **doAdjustMenus**

If the program is running on Mac OS X, `GetSheetWindowParent` is called as a way of determining whether the frontmost window is a sheet. If it is, the File and Demonstration menus are adjusted accordingly.

### **doTouchWindow**

`doTouchWindow` is called when the user chooses the Touch Window item in the Demonstration menu. Changing the content of the in-memory version of a file is only simulated in this program. The text “WINDOW TOUCHED” is drawn in window and the `windowTouched` field of the document structure is set to true.

`SetWindowModified` is called with true passed in the modified parameter. This causes the proxy icon to appear in the disabled state, indicating that the window has unsaved changes.

### **openAppEventHandler, reopenAppEventHandler, and openAndPrintDocsEventHandler**

The handlers for the first four required Apple events are essentially identical to those in the demonstration program `AppleEvents`. One major difference is that one handler (`openAndPrintDocsEventHandler`) is used for both the Open Documents and Print Documents events, with a value passed in the handler's `handlerRefcon` parameter advising the handler which of the two events has been received.

Most programs should simply open a new untitled window on receipt of an Open Application event. Accordingly, `openAppEventHandler` simply calls the same function (`doNewCommand`) as is called when the user chooses New from the File menu.

On receipt of a Re-Open Application event, if no windows are currently open, `doNewCommand` is called to open a window.

The demonstration program supports both 'TEXT' and 'PICT' files. On receipt of an Open Application event, it is thus necessary to determine the type of each file specified in the event. Accordingly, within `openAndPrintDocsEventHandler`, the call to `FSpGetFInfo` returns the Finder information from the volume catalog entry for the file relating to the specified `FSSpec` structure. The `fdType` field of the `FInfo` structure “filled-in” by `FSpGetFInfo` contains the file type. This, together with the `FSSpec` structure, is then passed in the call to `doOpenFile`. (`doOpenFile` is also called when the user chooses Open from the File menu.)

### **quitAppEventHandler**

Much of the code in `quitAppEventHandler` has to do with the requirement, on Mac OS X only, to present a Review Unsaved alert if more than one window with unsaved changes is open when the event is received.

If no windows are open, `QuitApplicationEventLoop` is called to close the application down. If at least one window is open, the following occurs.

`GetFrontWindowOfClass` is called to determine whether any window has a sheet. If so, that window is brought to the front and activated and the handler returns immediately, keeping the application alive.

The do-while loop walks the window list counting the number of document windows with unsaved changes (that is, “touched” windows) and, at the same time, bringing those windows to the front. At the next block, if there are no touched document windows, `QuitApplicationEventLoop` is called to close the application down.

If the application is running on Mac OS X, the following occurs:

- If there is only one touched window open, the flag `gQuittingApplication` is set to true and a `kEventWindowClose` event is created and sent to the front window. As will be see, this results in a sequence involving `doCloseCommand` and `doCloseDocWindow` whereby all untouched windows in front of the touched window are disposed of and a Save Changes alert is presented for the touched window. In this sequence, if the event handler for the Save Changes alert detects a Cancel button click, `gQuittingApplication` will be set to false, an action which will cause the process of closing down the remaining windows and the application to be terminated. If the Save or Don't Save buttons are clicked, all remaining windows will be closed down, and the program will be closed down by a call to `QuitApplicationEventLoop`, within the function `doCloseDocWindow`.
- If more than one window has been touched, `doReviewChangesAlert` is called to create, display and handle a Review Changes alert. If the Review Changes button is hit, the flag `gQuittingApplication` is set to true and a `kEventWindowClose` event is created and sent to the front window, resulting in the same general process of close-down, and possible termination of that close-down process, described above. If the Cancel button is hit, the flag `gQuittingApplication` is set to false (which defeats the execution of the last block of code in `doCloseDocWindow`) and `quitAppEventHandler` simply returns. If the Discard Changes button is hit, `QuitApplicationEventLoop` is called to terminate the program.

If the application is running on Mac OS 8/9, a Review Unsaved alert is not invoked. Instead, a `kEventWindowClose` event is created and sent to the front window. This results in the same general process of close-down, and possible termination of that close-down process, described above. If the Cancel button is not clicked in all Save Changes alerts, all windows will be closed down, and `QuitApplicationEventLoop` called, within the function `doCloseDocWindow`.

## NewOpenCloseSave.c

### Global Variables

`gModalToApplicationNavDialogRef` will be assigned the dialog reference for the Open File dialog, which is made application-modal. `gCurrentNumberOfWindows` keeps a count of the number of windows opened. `gDestRect` and `gViewRect` are used to set the destination and view rectangles for the `TextEdit` structures associated with 'TEXT' files.

### doNewCommand

doNewCommand is called when the user chooses New from the File menu and when an Open Application or Re-Open Application event is received.

Since this demonstration does not support the actual entry of text or the drawing of graphics, the document type passed to doNewDocWindow is immaterial. The document type 'TEXT' is passed in this instance simply to keep doNewDocWindow happy.

If doNewDocWindow returns no error, SetWindowProxyCreatorAndType is called to set the proxy icon for the window. (A new, untitled window, even though it has no associated file, needs a proxy icon to maintain visual consistency with other windows which have associated files.) The proxy icon will display in the disabled state, indicating, in this particular case, that the window has no associated file rather than unsaved changes.

The creator code and file type passed in the second and third parameters of SetWindowProxyCreatorAndType determine the icon to be displayed.)

### doOpenCommand

doOpenCommand, which is called when the user chooses Open from the File menu, uses Navigation Services 3.0 functions to create and display a application-modal Open dialog.

NavGetDefaultDialogCreationOptions initializes the specified NavDialogCreationOptions structure with the defaults.

GetIndString retrieves the application's name and assigns it to an Str255 variable. This is then converted to a CFString and assigned to the clientName field of the NavDialogCreationOptions structure. This will cause the application's name to appear in the dialog's title bar.

The next line assigns a value to the modality field of the NavDialogCreationOptions structure, which will cause the dialog to be application-modal.

An 'open' resource containing the file type list is then read in and the handle assigned a variable of type NavTypeListHandle. (The 'open' resource specifies that 'TEXT' and 'PICT' file types are supported.)

The call to NavCreateGetFileDialog creates the dialog. Since the default options are being used, multiple file selection is allowed. A universal procedure pointer to the event function getFilePutFileEventFunction, which will respond to button clicks in the dialog, is passed in the third parameter. No preview function or filter function is used, and no user data is passed in. The last parameter (a global variable) receives the dialog reference.

The call to NavDialogRun displays the dialog.

### **doCloseCommand**

`doCloseCommand` is called when the user chooses Close from the File menu or clicks in the window's go-away box. It is also called successively for each open window when a Quit Application Apple event is received.

The first two lines get a reference to the front window and establish whether the front window is a document window or a modeless dialog.

If the front window is a document window, the handle to the window's document structure is retrieved from the window's window object, allowing a check of whether the window is touched (that is, has unsaved changes). If it does, `doCreateAskSaveChangesDialog` is called to create and display a Save Changes alert and the function returns, otherwise `doCloseDocWindow` is called. Prior to the call to `doCreateAskSaveChangesDialog`, if the window is collapsed (Mac OS 8/9) or minimized in the dock (Mac OS X) it is first uncollapsed or brought out of the Dock.

No modeless dialogs are used by this program. However, if the front window was a modeless dialog, the appropriate action would be taken at the second case.

### **doSaveCommand**

`doSaveCommand` is called when the user chooses Save from the File menu or clicks the Save button in a Save Changes alert.

The first two lines get the `WindowRef` for the front window and retrieve the handle to that window's document structure. If a file currently exists for the document in this window, the function `doWriteFile` is called. The next four lines are incidental to the demonstration; they simply remove the words "WINDOW TOUCHED" from the window.

`SetWindowModified` is called with false passed in the modified parameter. This causes the window proxy icon to appear in the enabled state, indicating no unsaved changes.

### **doSaveAsCommand**

`doSaveAsCommand` uses Navigation Services 3.0 functions to create and display a window-modal Save Location dialog. It is called when the user chooses Save As from the File menu. It is also called by `doSaveCommand` if the user chooses Save when the front window contains a document for which no file currently exists.

`NavGetDefaultDialogCreationOptions` initializes the specified `NavDialogCreationOptions` structure with the defaults. The first line in the if block unsets the "allow saving of stationery files" bit (one of the defaults). On Mac OS 8/9, this means that the dialog will not contain the Format: pop-up menu.

GetWTitle gets the front window's title into an Str255 variable. This is then converted to a CFString and assigned to the saveFileName field of the NavDialogCreationOptions structure. This will be the default name for the saved file and will appear in the Name (OS 8/9) and Save As (OS X) edit text fields in the Save Location dialog.

The next two lines assign the application's name to the clientName field of the NavDialogCreationOptions structure. This will then appear in the dialog's title bar.

The next two lines assign the window reference to the parentWindow field of the NavDialogCreationOptions structure and assign a value to the modality field which will cause the dialog to be window-modal.

The next block gets the file type from the window's document structure into a local variable.

The call to NavCreatePutFileDialog creates the dialog. A universal procedure pointer to the event function getFilePutFileEventFunction, which will respond to button clicks in the dialog, is passed in the fourth parameter. The window reference is passed in the fifth (user data) parameter. This will be passed to the event function. The dialog reference is assigned to a field of the window's document structure.

The call to NavDialogRun displays the dialog.

### **doRevertCommand**

doRevertCommand, which is called when the user chooses Revert from the File menu, uses Navigation Services 3.0 functions to create and display a window-modal Discard Changes alert. The general approach is similar to that used to create and display the Save Location dialog, the main difference being that a universal procedure pointer to the event function askSaveDiscardEventFunction is stored in the askSaveDiscardEventFunctionUPP field of the window's document structure.

### **doNewDocWindow**

doNewDocWindow is called by doNewCommand and doOpenFile.

If the current number of open windows is the maximum allowable by this program, the function immediately exits, returning an error code which will cause an advisory error alert to be displayed.

The call to CreateNewWindow creates a new window with the standard document window attributes and with the standard window event handler installed. SetWTitle is called to set the window's title to "untitled". ChangeWindowAttributes is called to remove the zoom box/button and grow box from the window. The call to InstallWindowEventHandler installs the program's window event handler on the window.



The call to `NewHandle` allocates memory for the window's document structure. If this call is not successful, the window is disposed of and the function returns with the error code returned by `MemError`. The call to `SetWRefCon` assigns the handle to the document structure to the window structure's `refCon` field. The next block initializes fields of the document structure.

If the document type is 'TEXT', the if block executes, creating a `TextEdit` structure and assigning a handle to that structure to the `editStrucHdl` field of the document structure. (Note that the processes here are not explained in detail because `TextEdit` and `TextEdit` structures are not central to the demonstration. For the purposes of the demonstration, it is sufficient to understand that the text data retrieved from, and saved to, disk is stored in a `TextEdit` structure. (`TextEdit` is addressed in detail in Chapter 21.))

If the Boolean value passed to `doNewDocWindow` was set to true, the call to `ShowWindow` makes the window visible, otherwise the window is left invisible. The penultimate line increments the global variable which keeps track of the number of open windows.

### **doCloseDocWindow**

`doCloseDocWindow` is called from `doCloseCommand` when the subject window is not touched and from the Save Changes alert event handler `askSaveDiscardEventFunction` when the user clicks the Save or Don't Save buttons in a Save Changes alert.

The `FSClose` call closes the file, and `FlushVol` stores to disk all unwritten data currently in the volume buffer.

If the document is a text document, the `TextEdit` structure is disposed of. If it is a picture document, the `Picture` structure is disposed of. Finally, the document structure and window are disposed of and the global variable which keeps track of the number of open windows is decremented.

The last block executes only if `gQuittingApplication` has been set to true in the function `quitAppEventHandler`. If all windows have been closed, `QuitApplicationEventLoop` is called to terminate the program; otherwise a `kEventWindowClose` is created and sent to the front window, causing `doCloseCommand` to be called from the window event handler. This repetitive calling of `doCloseCommand` and `doCloseDocWindow` will continue until no windows remain or until `gQuittingApplication` is set to false by a click in the Cancel button in a Save Changes or, on Mac OS X only, a Review Unsaved alert.

### **doOpenFile**

`doOpenFile` opens a new document window and calls the functions, which read in the file. It is called by the event function `getFilePutFileEventFunction` when an Open button click occurs in an Open dialog. The event function passes the file system specification structure and document type to `doOpenFile`.

The call to `doNewDocWindow` opens a new window and creates an associated document structure. `SetWTitle` sets the window's title using information in the file system specification structure. `FSpOpenDF` opens the file's data fork. If this call is not successful, the window is disposed of and the function returns. The next three lines assign the file reference number and file system specification structure to the relevant fields of the document structure.

The next block calls the appropriate function for reading in the file, depending on whether the file type is of type 'TEXT' or 'PICT'. If the file is read in successfully, `ShowWindow` makes the window visible.

Just before the call to `ShowWindow`, `SetWindowProxyFSSpec` is called to establish a proxy icon for the window and associate the file with the window. (The creator code and file type of the file determine the icon to be displayed.) `GetWindowProxyAlias` assigns a copy of the alias data for the file to the `aliasHdl` field of the window's document structure. (This is used by the file synchronisation function.) `SetWindowModified` is called with `false` passed in the modified parameter. This causes the window proxy icon to appear in the enabled state, indicating no unsaved changes.

### **doCreateAskSaveChangesDialog**

`doCreateAskSaveChangesDialog`, which is called from `doCloseCommand`, uses Navigation Services 3.0 functions to create and display a window-modal Save Changes alert. The general approach is similar to that used to create and display the Discard Changes alert, but note that in this case that the `isAskSaveChangesDialog` field of the window's document structure is set to `true`.

Note also that, if the program is running on Mac OS 8/9, and if `gCloseDocWindow` is `true`, `doCloseDocWindow` is called to close the file, flush the volume, and close down the window. (`gCloseDocWindow` is set to `true` in the callback function `askSaveDiscardEventFunction` if the user clicks the Don't Save push button button in the Save Changes alert.)

### **doSaveUsingFSSpec**

As will be seen in the event function `getFilePutFileEventFunction`, when the user clicks on the Save button in a Save Location dialog, `AECoerceDesc` is called on the descriptor structure in the selection field of the `NavReplyRecord` structure in an attempt to coerce it to type `FSRef`. If the call is successful (meaning that the program is running on Mac OS X), `doSaveUsingFSRef` is called to perform the save using the HFS Plus API. If the call is not successful (meaning that the program is running on Mac OS 8/9) this function (`doSaveUsingFSSpec`) is called.

A descriptor structure is returned in the selection field of the `NavReplyRecord` structure. `AEGetNthPtr` coerces the descriptor structure to type `FSSpec` and stores the result in the local variable `fileSpec`.

The name field of `fileSpec` will be empty at this stage. Accordingly, the Navigation Services 3.0 function `NavDialogGetSaveFileName` is called to get a `CFStringRef` to the filename from the dialog object, which is converted to a Pascal string and assigned to the name field of `fileSpec`.

If the value in the replacing field of the `NavReplyRecord` structure indicates that the file is not being replaced, `FSpCreate` is called to create a new file of the specified type and with the application's signature as the specified creator. If this call is not successful, the `NavReplyRecord` structure is disposed of and the function returns.

The file system specification structure returned by the `FSpCreate` call is assigned to the `fileFSSpec` field of the window's document structure. If a file currently exists for the document, that file is closed by the call to `FSClose`. The data fork of the newly created file is then opened by a call to `FSpOpenDF`, the `fileRefNum` field of the document structure is assigned the file reference number returned by `FSpOpenDF`, the window's title is set to the new file's name, and the function `doWriteFile` is called to write the document to the new file. `NavCompleteSave` is called to complete the save operation.

Just before the call to `doWriteFile`, `SetWindowProxyFSSpec` is called to establish a proxy icon for the window and associate the file with the window. (The creator code and file type of the file determine the icon to be displayed.) `GetWindowProxyAlias` assigns a copy of the alias data for the file to the `aliasHdl` field of the window's document structure. (This is used by the file synchronization function.) `SetWindowModified` is called with `false` passed in the modified parameter. This causes the window proxy icon to appear in the enabled state, indicating no unsaved changes.

### **doSaveUsingFSRef**

`doSaveUsingFSRef`, which is called from the event function `getFilePutFileEventFunction`, performs the save using the HFS Plus API. The main if block executes only if the call to `AECoerceDesc` is successful in coercing the descriptor structure in the selection field of the `NavReplyRecord` to type `FSRef`.

In Carbon, the `dataHandle` field of descriptor structures is opaque. Thus `AEGetDescData` is used to extract the data in this field, which is assigned to the local variable `fsRefParent`. This is the `FSRef` for the parent directory.

At the next block, `CFStringGetLength` is called to get the number of 16-bit Unicode characters in the `saveFileName` field of the `NavReplyRecord` structure. This facilitates the call to `CFStringGetCharacters`, which extracts the contents of the string into a buffer.

If the value in the replacing field of the `NavReplyRecord` structure indicates that the file is being replaced, the existing file is first deleted. `FSPMakeFSRefUnicode`, given a parent directory and Unicode file name, creates an `FSRef` for the file. This is passed in the call to `FSDeleteObject`, which deletes the file.

The call to `FSCreateFileUnicode` creates a new file with the Unicode name. On return, the last parameter contains a file system specification structure for the new file. (Although the file is created with a Unicode name, it can be written using a file system specification structure.)

The call to `FSpGetFInfo` gets the Finder information from the volume catalog entry for the file. The file type extracted from the window's document structure is then assigned to the `fdType` field of the returned `FInfo` structure, following which `FSpSetFInfo` is called to set the new Finder information in the file's volume catalog entry.

The file system specification structure is assigned to the `fileFSSpec` field of the window's document structure.

The data fork of the newly created file is then opened by a call to `FSpOpenDF`, the `fileRefNum` field of the document structure is assigned the file reference number returned by `FSpOpenDF`, the window's title is set to the new file's name, and the function `doWriteFile` is called to write the document to the new file. `NavCompleteSave` is called to complete the save operation.

Just before the call to `doWriteFile`, `SetWindowProxyFSSpec` is called to establish a proxy icon for the window and associate the file with the window. (The creator code and file type of the file determine the icon to be displayed.) `GetWindowProxyAlias` assigns a copy of the alias data for the file to the `aliasHdl` field of the window's document structure. (This is used by the file synchronisation function.) `SetWindowModified` is called with `false` passed in the modified parameter. This causes the window proxy icon to appear in the enabled state, indicating no unsaved changes.

### **doWriteFile**

`doWriteFile` is called by `doSaveCommand`, `doSaveUsingFSSpec`, and `doSaveUsingFSRef`. In conjunction with two supporting functions, it writes the document to disk using the "safe-save" procedure.

The first two lines retrieve a handle to the document structure and the file system specification from the document structure.

The next two lines create a temporary file name which is bound to be unique. `FindFolder` finds the temporary folder on the file's volume, or creates a temporary folder if necessary. `FSMakeFSSpec` makes a file system specification structure for the temporary file, using the volume reference number and parent directory ID returned by the `FindFolder` call. `FSpCreate` creates the temporary file in that directory on that volume, and `FSpOpenDF` opens the file's data fork.

Within the next if block, the appropriate function is called to write the document's data to the temporary file.

The two calls to `FSClose` close both the temporary and existing files prior to the call to `FSpExchangeFiles`, which swaps the files' data. The temporary file is then deleted and the data fork of the existing file is re-opened.

The function `doCopyResources` is called to copy the missing application name string resource from the resource fork of the application file to the resource fork of the new document file. If the file type is 'PICT', a 'pnot' resource and associated 'PICT' resource is also copied to the resource fork.

### **doReadTextFile**

`doReadTextFile` is called by `doOpenFile` and the event function `askSaveDiscardEventFunction` to read in data from an open file of type 'TEXT'.

The first two lines retrieve the file reference number from the document structure.

The next three lines retrieve the handle to the `TextEdit` structure from the document structure and modify the text size and line height fields of the `TextEdit` structure.

`SetFPos` sets the file mark to the beginning of the file. `GetEOF` gets the number of bytes in the file. If the number of bytes exceeds that which can be stored in a `TextEdit` structure (32,767), the number of bytes which will be read from the file is restricted to 32,767.

`NewHandle` allocates a buffer equal to the size of the file (or 32,767 bytes if the preceding if statement executed). `FSRead` reads the data from the file into the buffer. `MoveHHI` and `HLockHI` move the buffer high in the heap and lock it preparatory to the call to `TESetText`. `TESetText` copies the text in the buffer into the existing `hText` handle of the `TextEdit` edit structure. The buffer is then unlocked and disposed of.

### **doReadPictFile**

`doReadPictFile` is called by `doOpenFile` and the event function `askSaveDiscardEventFunction` to read in data from an open file of type 'PICT'.

The first two lines retrieve the file reference number from the document structure. `GetEOF` gets the number of bytes in the file. `SetFPos` sets the file mark 512 bytes (the size of a 'PICT' file's header) past the beginning of the file, and the next line subtracts the header size from the total size of the file. `NewHandle` allocates memory for the `Picture` structure and `FSRead` reads in the file's data.

### **doWriteTextData**

`doWriteTextData` is called by `doWriteFile` to write text data to the specified file.

The first two lines retrieve the handle to the `TextEdit` structure from the document structure. The number of bytes of text is then retrieved from the `teLength` field of the `TextEdit` structure.

SetFPos sets the file mark to the beginning of the file. FSWrite writes the specified number of bytes to the file. SetEOF adjusts the file's size. FlushVol stores to disk all unwritten data currently in the volume buffer.

The penultimate line sets the windowTouched field of the document structure to indicate that the document data on disk equates to the document data in memory.

### **doWritePictData**

doWritePictData is called by doWriteFile to write picture data to the specified file.

The first two lines retrieve the handle to the relevant Picture structure from the document structure. SetFPos sets the file mark to the start of the file. FSWrite writes zeros in the first 512 bytes (the size of a 'PICT' file's header). GetHandleSize gets the size of the Picture structure and FSWrite writes the bytes in the Picture structure to the file. SetEOF adjusts the file's size and FlushVol stores to disk all unwritten data currently in the volume buffer.

The penultimate line sets the windowTouched field of the document structure to indicate that the document data on disk equates to the document data in memory.

### **getFilePutFileEventFunction**

getFilePutFileEventFunction is the event (callback) function pertaining to the Open, Save Location, and Choose a Folder dialogs. It responds to button clicks in those dialogs.

When the user has clicked one of the dialog's buttons, the kNavCBUserAction message is received in the callbackSelector formal parameter. When this message is received, the first action is to call NavDialogGetReply to get a NavReplyRecord structure containing information about the dialog session. NavDialogGetUserAction is then called to get the user action which dismissed the dialog.

If the user clicked the Open button in an Open dialog, AECCountItems is called to count the number of descriptor structures in the descriptor list returned in the selection field of the NavReplyRecord structure, and which is created from FSSpec references to items selected in the Open dialog. The for loop repeats for each of the descriptor structures. AEGetNthPtr gets the file system specification into a local variable of type FSSpec. This file system specification is then passed in the first parameter of a call to FSpGetFInfo, allowing the file type to be ascertained. The file system specification and file type are then passed in a call to the function doOpenFile, which creates a new window and reads in the file.

If the user clicked the Save button in a Save Location dialog, the window reference received in the callbackUD formal parameter is assigned to the local variable windowRef. (Recall that the window reference for the front window was passed in the fifth parameter of the call to NavCreatePutFileDialog.) The next task is to determine which of the two file saving

functions (`doSaveUsingFSSpec` or `doSaveUsingFSRef`) should be called to save the file. Accordingly, `AECoerceDesc` is called in an attempt to coerce the descriptor structure in the selection field of the `NavReplyRecord` structure to type `FSRef`. If the call is successful, `doSaveUsingFSRef` is called; if not, `doSaveUsingFSSpec` is called.

If the user clicked the Choose button in a Choose a Folder dialog, `AEGetNthPtr` is called to get the file system specification into a local variable of type `FSSpec`. When a file system specification describes a directory, as it does in this case, the name field is empty and the `parID` field contains the directory ID of that directory, not the ID of the parent directory. In this demonstration, the volume reference number and directory ID are passed in a call to `FSMakeFSSpec`, which fills in the fields of the `FSSpec` record pointed to by the fourth parameter. The contents of the fields of this `FSSpec` structure (the directory name, its parent directory ID, and the volume reference number) are then drawn in the bottom of the front window.

Before exit from the `kNavCBUserAction` case, `NavDisposeReply` is called to release the memory allocated for the `NavReplyRecord` structure.

When the user has clicked a dialog's Cancel button, the `kNavCBTerminate` message is received in the `callbackSelector` formal parameter. When this message is received, if a dialog reference has been assigned to the global variable `gModalToApplicationNavDialogRef` (as it will be in the case of the application-modal Open and Choose a Folder dialogs), the dialog is disposed of and the global variable is assigned `NULL`. If `gModalToApplicationNavDialogRef` contains `NULL`, the window reference received in the `callbackUD` formal parameter is assigned to the local variable `windowRef`. (Recall that the window reference for the front window was passed in the fifth parameter of the call to `NavCreatePutFileDialog`.) A handle to the window's document structure is then retrieved, allowing access to the dialog reference stored in that structure. The dialog is disposed of and the relevant field of the document structure is assigned `NULL`.

Note that, in Carbon applications, there is no need to respond to the `kNavCBEvent` message in this event function or the following event function in order to call the application's window updating function. This is assuming the standard window event handler is installed on the relevant windows, the application registers for the `kEventWindowDrawContent` event type, and calls its window updating function when that event type is received. The following example is provided for those circumstances in which these conditions are not met:

```
case kNavCBEvent:
    switch(callbackParms->eventData.eventDataParms.event->what)
    {
        case updateEvt:
            windowRef = (WindowRef) callbackParms->eventData.eventDataParms.event->message;
            if(GetWindowKind(windowRef) != kDialogWindowKind)
                doUpdate((EventRecord *) callbackParms->eventData.eventDataParms.event);
            break;
    }
    break;
```



### **askSaveDiscardEventFunction**

`askSaveDiscardEventFunction` is the event (callback) function pertaining to the Save Changes and Discard Changes alerts. It responds to button clicks in those dialogs.

When the user has clicked one of the dialog's buttons, the `kNavCBUserAction` message is received in the `callBackSelector` formal parameter. When this message is received, the first action is to get a handle to the front window's document structure. (Recall that the reference to the front window was passed in the third parameter of the `NavCreateAskSaveChangesDialog` and `NavCreateAskDiscardChangesDialog` calls.) The main if block executes only if the `modalToWindowNavDialogRef` field of the document structure contains a dialog reference.

If the user clicked the Save button in a Save Changes alert, `doSaveCommand` is called to save the file and execution falls through to the `kNavUserActionDontSaveChanges` case where `doCloseDocWindow` is called to close the file, flush the volume, and close down the window.

If the user clicked the Don't Save button in a Save Changes alert, and if the program is running on Mac OS X, `doCloseDocWindow` is called to close the file, flush the volume, and close down the window. If the program is running on Mac OS 9, the global variable `gCloseDocWindow` is set to true, causing the `doCloseDocWindow` call to occur in the function `doCreateAskSaveChangesDialog`. Before all this occurs, `NavDialogDispose` is called to dispose of the alert before the window is closed by the call to `doCloseDocWindow`.

If the user clicked the OK button in a Discard Changes alert, the window's content area is erased and the appropriate function (`doReadTextFile` or `doReadPictFile`) is called depending on whether the file type is 'TEXT' or 'PICT'. In addition, the window's "touched" field in the document structure is set to false and `InvalidWindowRect` is called to force a redraw of the window's content region. Just before the `InvalidWindowRect` call, `SetWindowModified` is called with false passed in the modified parameter. This causes the window proxy icon to appear in the enabled state, indicating no unsaved changes. The Discard Changes alert is then disposed of.

If the user clicked the Cancel button in a Save Changes or Discard Changes alert, and if it is a Save Changes alert, the flag `gQuittingApplication` is set to false. This has the effect of defeating the execution of the last block of code in the function `doCloseDocWindow`. (Recall that the `isAskSaveChangesDialog` field of the window's document structure is set to true when such alerts are created.) The alert is then disposed of.

### **doCopyResources**

`doCopyResources` is called by `doWriteFile`. It copies the missing application name string resource from the resource fork of the application file to the resource fork of the new file. If the file type is PICT, a 'pnot' resource and associated 'PICT' resource is also copied. If the program is running on Mac OS 8/9 and the file type is TEXT, a 'pnot' resource, together with a 'TEXT' resource created within the function, are also copied. (For 'TEXT' files, previews are automatically created on Mac OS X.)



The first line retrieves a handle to the file's document structure. The next four lines establish the file type involved. `FSpCreateResFile` creates the resource fork in the new file and `FSpOpenResFile` opens the resource fork. The function for copying specified resources between specified files (`doCopyAResource`) is then called to copy the missing application name string resource from the resource fork of the application file to the resource fork of the new file.

If the file type is PICT, a 'pnot' resource and associated PICT resource is copied so as to provide a preview for PICT files in the Open dialog. (Of course, in a real application, the 'pnot' and PICT resource would be created by the application for each separate PICT file.)

If the program is running on Mac OS 8/9 and the file type is TEXT, a 'pnot' resource is copied and a TEXT resource is created and copied so as to provide a preview for 'TEXT' files in the Open dialog. After the 'pnot' resource is copied, a relocatable block is created and 1024 bytes of the text in the TextEdit structure is copied to that block. `AddResource` turns that arbitrary data in memory into a TEXT resource, assigns a resource type, ID, and name to that resource, and inserts an entry in the resource map for the current resource file (in this case, the resource fork of the TEXT file). `UpdateResFile` then writes the resource map and data to disk.

`CloseResFile` closes the resource fork of the new file.

### **doCopyAResource**

`doCopyAResource` copies specified resources between specified files. In this program, it is called only by `doCopyResources`.

`UseResFile` sets the application's resource fork as the current resource file. `GetResource` reads the specified resource into memory.

`GetResInfo`, given a handle, gets the resource type, ID and name. (Note that this line is included only because of the generic nature of `doCopyResource`. The calling function has passed `doCopyResource` the type and ID in this instance.)

`DetachResource` removes the resource's handle from the resource map without removing the resource from memory, and converts the resource handle into a generic handle. `UseResFile` makes the new file's resource fork the current resource file. `AddResource` makes the now arbitrary data in memory into a resource, assigns a resource ID, type and name to that resource, and inserts an entry in the resource map for the current resource file. `UpdateResFile` then writes the resource map and data to disk.

## **SynchroniseFiles.c**

### **doSynchroniseFiles**

`doSynchroniseFiles` is called from `doIdle` when the installed timer fires (every 15 ticks when a document window is the front window).

A reference to the front non-floating window is obtained. The while loop walks the document window section of the window list (see the call to `GetNextWindow` at the bottom of the loop) looking for associated files whose locations have changed. When the last window in the list has been examined, the loop exits.

Within the while loop, `GetWRefCon` is called to retrieve the handle to the window's document structure.

If the `aliasHdl` field of the window's document structure contains `NULL`, the window does not yet have a file associated with it, in which case execution falls through to the next iteration of the while loop and the next window is examined.

If the window has an associated file, the handle to the associated alias structure, which contains the alias data for the file, is retrieved. `ResolveAlias` is then called to perform a search for the target of the alias, returning the file system specification for the target file in the third parameter. After identifying the target, `ResolveAlias` compares some key information about the target with the information in the alias structure. If the information differs, `ResolveAlias` updates the alias structure to match the target and sets the `aliasChanged` parameter to true.

If the `aliasChanged` parameter is set to true, meaning that the location of the file has changed, the `fileFSSpec` field of the window's document structure is assigned the file system specification structure returned by `ResolveAlias`. Since it is also possible that the user has renamed the file, `SetWTitle` is called to set the window's title to the filename contained in the name field of the file system specification structure returned by `ResolveAlias`.

The next task is to determine whether the user has moved the file to the trash or to a folder in the trash, in which case the document must be closed.

`FindFolder` is called to get the volume reference number and parent directory ID of the trash folder. (Note that `kUserDomain` is passed in the `vRefNum` parameter. On Mac OS 8/9, this is mapped to `kOnSystemDisk`.)

The do/while loop walks up the parent folder hierarchy to the root folder. At the first line in the do/while loop, if the root folder has been reached (`fsRtParID` is the parent ID of the root directory), the file is not in the trash, in which case the loop exits at that point. At the next if statement, the volume reference number and parent directory ID of the file are compared with the volume reference number and directory ID of the trash. If they match, the file is closed, its associated memory is disposed of, and the window is disposed of.

The bottom line of the do/while loop effects the walk up the parent directory hierarchy, `FSMakeFSSpec` creates a file system specification structure from the current contents of the `vRefNum` and `parID` fields of `newFSSpec`. Since `newFSSpec` is also the target, the `parID` field is "filled in" again, at every iteration of the loop, with the parent ID of the directory passed in the second parameter of the `FSMakeFSSpec` call.

## ChooseAFolderDialog.c

### doChooseAFolderDialog

doChooseAFolderDialog, which is called when the user chooses the Choose a Folder Dialog item in the demonstration menu, creates and displays a Choose a Folder dialog.

NavGetDefaultDialogCreationOptions initialises the specified NavDialogCreation Options structure with the defaults. GetIndString retrieves a Pascal string, which is converted to a CFString and assigned to the message field of a NavDialogOptions structure. This will appear immediately below the browser list in the Mac OS 8/9 dialog and above the browser list in the Mac OS X dialog.

The next line ensures that the dialog will be application-modal.

NavCreateChooseFolderDialog creates the dialog and NavDialogRun displays it.

# More on Resources and Core Foundation Preferences

## CHAPTER

# 19

## IN THIS CHAPTER

- Introduction 1050
- Search Path for Resources 1050
- Releasing and Detaching Resources 1052
- Creating, Opening, and Closing Resource Forks 1052
- Reading and Manipulating Resources 1054
- Writing Resources 1054
- Partial Resources 1055
- Application Preferences 1055
- Main Resource Manager Constants, Data Types and Functions 1057
- Main Core Foundation Preferences Services Functions 1058
- Demonstration Program MoreResources Listing 1059
- Demonstration Program MoreResources Comments 1082

## Introduction

Chapter 1 covered the basics of creating standard resources for an application's resource file and with reading in standard resources from application files and the system. In addition, the demonstration programs in preceding chapters have all involved the reading in of standard resources from those files.

This chapter is concerned with aspects of resources not covered in Chapter 1, including search paths, detaching and copying resources, creating, opening, and closing resource files, and reading from and writing to resource files. In addition, the accompanying demonstration program demonstrates the creation of **custom resources**, together with reading such resources from, and writing them to, the resource forks of files other than application and System files.

This chapter also addresses the matter of storing and retrieving application preferences using Core Foundation Preferences Services.

## Search Path for Resources

### Preamble

The Resource Manager follows a defined search path to find a resource when you use a Resource Manager function to read, or perform an operation on, a resource,. The different files whose resource forks may constitute the search path are therefore of some relevance. The following summarizes the typical locations of resources used by an application:

<i>Resource Fork of</i>	<i>Typical Resources Therein</i>	<i>Comments</i>
System file	Sounds (Mac OS 8/9), icons, cursors, and so on.	On startup, the Resource Manager creates a special zone within the system heap, creates a resource map which points to system-resident resources, opens the resource fork of the System file, and reads its resource map into memory.
Application file	Descriptions of menus, windows, controls, icons, and so on. Text used in dialogs, help balloons, and so on.	When a user opens an application, system software automatically opens the application's resource fork.

<i>Resource Fork of</i>	<i>Typical Resources Therein</i>	<i>Comments</i>
Application's Preferences file	The user's global preferences for the application.	An application should typically open the Preferences file at application launch, and leave it open.
Application's document file	Information specific only to the document, such as its window's last size and location.	When an application opens a document file, it should typically open the file's resource fork as well as its data fork.

## Current Resource File

When your application opens the resource fork of a file, that file becomes the **current resource file**. However, your application can change the current resource file, if necessary, using the function `UseResFile`.

The current resource file is always the first file in the search path. It is also the file on which most Resource Manager functions assume they should operate.

### NOTE

The resource fork of a file is also called the resource file because, in some respects, you can treat it as if it were a separate file.

## Default Search Order

During its search for a resource, if the Resource Manager cannot find the resource in the current resource file, it continues searching until it either finds the resource or has searched all files in the search path.

The Resource Manager normally looks first in the resource map in memory of the last resource fork your application opened. If the resource is not found there, the resource maps of each resource file open to your application are searched in reverse order of opening. If the resource is not found there, your application's resource map is searched. If the resource has still not been found, the search continues in the System file's resource map.

## Implications of the Default Search Order

The implications of this search order are that it allows your application to:

- Access resources in the System file.
- Override resources in the System file.

- Override your application's resources with document-specific resources.
- Share a resource amongst multiple files by storing it in the application's resource fork.

## Setting the Current Resource File To Dictate the Search Order

You can, of course, rely on the Resource Manager's search order to find a particular resource; however, it is best to set the current resource file to the file containing the desired resource before reading and writing resource data. This ensures that that file will be searched first, thus possibly obviating unnecessary searches of other files.

As previously stated, the function `UseResFile` is used to set the current resource file. Note that `UseResFile` takes as its single parameter a **file reference number**, which identifies an access path to the resource fork. The Resource Manager assigns a resource file a file reference number when it opens that file.

You can get the file reference number of the current resource file using the function `CurResFile`.

## Restricting the Search to the Current Resource File

The search path may be restricted to the current resource file by using Resource Manager functions (such as `Get1Resource`), which look only in the current resource file's resource map when searching for a specific resource.

## Releasing and Detaching Resources

When you have finished using a resource, you typically call `ReleaseResource`, which sets the handle's master pointer to `NULL` and releases the memory associated with the resource.

Your application can use `DetachResource` to replace a resource's handle in the resource map with `NULL` without releasing the associated memory. You will then be able to access the resource's data directly, without the aid of Resource Manager functions, and you will be able to pass the handle to a function which does not accept a resource handle. For example, the `AddResource` function, which makes arbitrary data in memory into a resource, requires a handle to data, not a handle to a resource.

`DetachResource` is useful when you want to copy a resource. The procedure is to read in the resource using `GetResource`, detach the resource to disassociate it from its resource file, and then copy the resource to a destination file using `AddResource`.



## Creating, Opening, and Closing Resource Forks

### Opening an Application's Resource Fork

As previously stated, the system software automatically opens your application's resource fork at application launch. The only action required by your application at launch is to call `CurResFile` to save the file reference number for the application's resource fork.

### Creating and Opening a Resource Fork

#### Creating a Resource Fork

If your application needs to save resources to the resource fork of a file, and assuming the resource fork does not already exist, it must first create the resource fork. A call to `FSpCreateResFile` will create the resource fork. `FSpCreateResFile` requires four parameters: a file system specification structure, the application's signature, the file type, the script code. The effect of `FSpCreateResFile` varies as follows:

- If the file specified by the file system specification structure does not already exist, the function
  - Creates a file with an empty resource fork and resource map.
  - Sets the creator, type, and script code fields of the file's catalog information structure to the specified values.
- If the data fork of the file specified by the file system specification structure already exists but the file has a zero-length resource fork, the function
  - Creates an empty resource fork and resource map.
  - Changes the creator, type, and script code fields of the catalog information structure of the file to the specified values.
- If the file specified by the file system specification structure already exists and includes a resource fork with a resource map, the function does nothing.

#### Opening a Resource Fork

After creating a resource fork, and before attempting to write to it, you must open it using `FSpOpenResFile`. `FSpOpenResFile` returns a file reference number which, as previously stated, may be used to change or limit the Resource Manager's search order.

#### NOTE

Note that, although the file reference number for the data fork and the resource fork usually match, you should not assume that this is always the case.



As previously stated, when you open a resource fork, the Resource Manager resets the search path so that the file whose resource fork you just opened becomes the current resource file.

After opening a resource fork, you can use Resource Manager functions to write resources to it.

#### NOTE

It is possible to write to the resource fork using File Manager functions. However, in general, you should always use Resource Manager functions.

## Closing a Resource Fork

When you are finished using a resource fork that your application explicitly opened, you should close it using `CloseResFile`. Note that the Resource Manager automatically closes any resource forks opened by your application that are still open when your application calls `ExitToShell`.

## Reading and Manipulating Resources

Depending on which Resource Manager function is used to read resources from a resource fork, you specify the resource to be read by either its resource type and resource ID or its resource type and resource name.

## Reading From the Resource Map Without Loading the Resource

Those Resource Manager functions that return handles to resources normally read the resource data into memory if it is not already there. Sometimes, however, you may want to read, say, resource types and attributes from the resource map without reading the resource data into memory. Calling `SetResLoad` with the `load` parameter set to `false` causes subsequent calls to those functions which return handles to resources to *not* load the resource data to memory. (To read the resource data into memory after a call to `SetResLoad` with the `load` parameter set to `false`, call `LoadResource`.)

If you call `SetResLoad` with the `load` parameter set to `false`, be sure to call it again with the parameter set to `true` as soon as possible. Other parts of the system software that call the Resource Manager rely on the default setting (that is, the `load` parameter set to `true`), and some functions will not work properly if resources are not loaded automatically.

## Indexing Through Resources

The Resource Manager provides functions that let you index through all resources of a given type (for example, using `CountResources` and `GetIndResource`). This can be useful when you want to read all resources of a given type.

## Writing Resources

When you have opened a resource fork, you can write resources to it (assuming it is the current resource file).

A call to `AddResource` creates a new entry for a resource in the resource map in memory (but not on the disk) and sets that entry's location to refer to that resource's data. A call to either `UpdateResFile` or `WriteResFile` will then write the resource to disk. Note that you usually need to set the current resource file to the desired file before calling `AddResource` because `AddResource` always adds the resource to the resource map in memory, which corresponds to the current resource file.

When you change a resource referenced through the resource map in memory, you should call `ChangedResource` to set the `resChanged` attribute of that resource's resource map entry. `ChangedResource` reserves enough disk space to contain the changed resource. Immediately after calling `ChangedResource`, you should call `UpdateResFile` or `WriteResFile` to write the changed resource data to disk.

The difference between `UpdateResFile` and `WriteResFile` is as follows:

- `UpdateResFile` writes to disk only those resources that have been added or changed. It also writes the entire resource map to disk, overwriting its previous contents.
- `WriteResFile` writes only a single resource to disk and does not update the resource's entry in the resource map on disk.

## Care with Purgeable Resources

If you are changing purgeable resources, you should use the Memory Manager function `HNoPurge` to ensure that the Resource Manager does not purge the resource while your application is in the process of changing it.

## Partial Resources

Some resources, such as 'snd ' (Mac OS 8/9) and 'sfnt' resources, can be too large to fit into available memory. In these cases, you can read a portion of the resource into memory, or alter a section of the resource while it is still on disk, using the functions `ReadPartialResource` and `WritePartialResource`.

## Application Preferences

Many applications allow the user to set application preferences, which the application stores in a preferences file and retrieves when the application is launched. On Mac OS 8/9, your Preferences file should be located in the special folder titled Preferences provided by the operating system. The Preferences folder is located in the System folder. On Mac OS X,

preferences are stored in the Preferences folder in the Library folder in each user's home directory (~/.Library/Preferences).

You can save your application's preferences as a custom resource to the resource fork of your preferences file. Alternatively, and more correctly in the Mac OS X era, you can use the methodology provided by Core Foundation Preferences Services.

## Using Core Foundation Preferences Services

Using Core Foundation Preferences Services involves storing values associated with a key, the key being used to later retrieve the value. The concept is similar to that applying to the key/value pairs used in information property lists (see Chapter 9).

### Application ID

The name of the file in which Preference Services stores preferences information is specified by an **application ID**. For Mac OS X, this should be the same as the name associated with the `CFBundleIdentifier` key in the information property list in your application's 'plist' resource. It thus takes the form of a Java package name, that is, a unique domain name followed by the application's name (for example, `com.MyCompany.MyApplication`). For Mac OS 8/9, it is sufficient to simply use the application's name. (Indeed, this abbreviation will be essential if the application ID in Java package form exceeds the 31-character limit for Mac OS 8/9 file names.)

### Setting, Storing, and Retrieving a Preference

You use the function `CFPreferencesSetAppValue` to set a preferences value. The following example sets a value, which specifies that the application should use a full screen display:

```
CFStringRef applicationID = CFSTR("com.MyCompany.MyApplication");
CFStringRef fullScreenKey = CFSTR("fullScreen");
CFStringRef yes           = CFSTR("yes");
CFStringRef no            = CFSTR("no");
```

```
CFPreferencesSetAppValue(fullScreenKey, yes, applicationID);
```

`CFPreferencesSetAppValue` stores the value in a cache owned by your application. To flush the cache to permanent storage, you must call the function `CFPreferencesAppSynchronize`, passing in the application ID.

You would use the function `CFPreferencesGetAppBooleanValue` to retrieve the value, as in the following example:

```
CFStringRef applicationID = CFSTR("com.MyCompany.MyApplication");
CFStringRef fullScreenKey = CFSTR("fullScreen");
Boolean      booleanValue, success;
```

```
booleanValue = CFPreferencesGetAppBooleanValue(fullScreenKey, applicationID, &success);
```

You can use `CFPreferencesGetAppIntegerValue` to retrieve integer values (which are stored as strings) in the same way.

## Preference Domains

Preference Services uses the concept of **domains** when creating or searching for a preference. User name, host name, and application ID identify a domain. `CFPreferencesSetAppValue` uses the current user and “any host” domain qualifiers as the default, which is why only the application ID is passed in the function call. Alternative low-level Preferences Services functions are available to specify an exact domain.

# Main Resource Manager Constants, Data Types and Functions

## Constants

### Resource Attributes

```
resSysHeap    = 64  System or application heap?
resPurgeable  = 32  Purgeable resource?
resLocked     = 16  Load it in locked?
resProtected  = 8   Protected?
resPreload    = 4   Load in on OpenResFile?
resChanged    = 2   Resource changed?
```

## Data Types

```
typedef unsigned long  FourCharCode;
typedef FourCharCode  ResType;
```

## Functions

### Initializing the Resource Manager

```
short  InitResources(void);
```

### Checking for Errors

```
short  ResError(void);
```

### Creating an Empty Resource Fork

```
void  FSpCreateResFile(const FSSpec *spec, OSType creator, OSType fileType, ScriptCode
scriptTag);
```

### Opening Resource Forks

```
short  FSpOpenResFile(const FSSpec *spec, SignedByte permission);
```

### Getting and Setting the Current Resource File

```
void  UseResFile(short refNum);
short  CurResFile(void);
short  HomeResFile(Handle theResource);
```

### Reading Resources into Memory

```
Handle  GetResource(ResType theType, short theID);
Handle  Get1Resource(ResType theType, short theID);
Handle  GetNamedResource(ResType theType, ConstStr255Param name);
```

```
Handle  Get1NamedResource(ResType theType,ConstStr255Param name);
void    SetResLoad(Boolean load);
void    LoadResource(Handle theResource);
```

### Getting and Setting Resource Information

```
void    GetResInfo(Handle theResource,short *theID,ResType *theType,Str255 name);
void    SetResInfo(Handle theResource,short theID,ConstStr255Param name);
short   GetResAttrs(Handle theResource);
void    SetResAttrs(Handle theResource,short attrs);
```

### Modifying Resources

```
void    ChangedResource(Handle theResource);
void    AddResource(Handle theResource,ResType theType,short theID,ConstStr255Param name);
```

### Writing to Resource Forks

```
void    UpdateResFile(short refNum);
void    WriteResource(Handle theResource);
```

### Getting a Unique Resource ID

```
short   UniqueID(ResType theType);
short   Unique1ID(ResType theType);
```

### Counting and Listing Resource Types

```
short   CountResources(ResType theType);
short   Count1Resources(ResType theType);
Handle   GetIndResource(ResType theType,short index);
Handle   Get1IndResource(ResType theType,short index);
short   CountTypes(void);
short   Count1Types(void);
void     GetIndType(ResType *theType,short index);
void     Get1IndType(ResType *theType,short index);
```

### Getting Resource Sizes

```
long     GetResourceSizeOnDisk(Handle theResource);
long     GetMaxResourceSize(Handle theResource);
```

### Disposing of Resources and Closing Resource Forks

```
void     ReleaseResource(Handle theResource);
void     DetachResource(Handle theResource);
void     RemoveResource(Handle theResource);
void     CloseResFile(short refNum);
```

### Getting and Setting Resource Fork Attributes

```
short    GetResFileAttrs(short refNum);
void     SetResFileAttrs(short refNum,short attrs);
```

## Main Core Foundation Preferences Services Functions

```
void     CFPreferencesSetAppValue(CFStringRef key,CFPropertyListRef value,
CFStringRef applicationID);
void     CFPreferencesSetValue(CFStringRef key,CFPropertyListRef value,
CFStringRef applicationID,CFStringRef userName,CFStringRef hostName);
```

```

Boolean CFPREFERENCESAppSynchronize(CFStringRef applicationID);
Boolean CFPREFERENCESSynchronize(CFStringRef applicationID,CFStringRef userName,
    CFStringRef hostName);
Boolean CFPREFERENCESGetAppBooleanValue(CFStringRef key,CFStringRef applicationID,
    Boolean *keyExistsAndHasValidFormat);
CFIndex CFPREFERENCESGetAppIntegerValue(CFStringRef key,CFStringRef applicationID,
    Boolean *keyExistsAndHasValidFormat);

```

## Demonstration Program MoreResources Listing

```

// *****
// MoreResources.c CARBON EVENT MODEL
// *****
//
// This program uses custom resources to:
//
// • Store application preferences in the resource fork of a Preferences file.
//
// • Store, in the resource fork of a document file:
//
// • The size and position of the window associated with the document.
//
// • A flattened PMPageFormat object containing information about how the pages of the
// document should be printed, for example, on what paper size, in what printable
// area, and in what orientation (landscape or portrait).
//
// The program also demonstrates setting, storing, and retrieving application preferences
// using Core Foundation Preferences Services.
//
// The program utilises the following standard resources:
//
// • A 'plst' resource.
//
// • An 'MBAR' resource, and 'MENU' resources for OS9Apple/Application, File, Edit and
// Demonstration menus (preload, non-purgeable).
//
// • A 'DLOG' resource (purgeable) and associated 'dlgx', 'DITL' and 'CNTL' resources
// (purgeable) associated with the display of, and user modification of, current
// application preferences.
//
// • A 'STR#' resource (purgeable) containing the required name of the preferences file
// created by the program.
//
// • A 'STR ' resource (purgeable) containing the application-missing string, which is copied
// to the resource fork of the preferences file.
//
// • A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
// doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// The program creates and utilises the following custom resources:
//
// • A 'PrFn' (preferences) resource comprising three boolean values, which is located in the
// program's resource file, which contains default preference values, and which is copied
// to the resource fork of a preferences file created when the program is run for the first
// time. Thereafter, the 'PrFn' resource in the preferences file is used for the storage
// and retrieval of application preferences set by the user.
//

```

```

// · A 'WiSp' (window size and position) resource, which is created in the resource fork of
//   the document file used by the program, and which is used to store the associated
//   window's port rectangle converted to global coordinates.
//
// · A 'PgFt' (page format) resource, which is created in the resource fork of the document
//   file used by the program, and which is used to store a flattened PMPageFormat object.
//
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenubar          128
#define mAppleApplication 128
#define iAbout            1
#define mFile             129
#define iOpen             2
#define iClose            4
#define iPageSetup        9
#define iQuit             12
#define mEdit             130
#define iPreferences      10
#define rPrefsDialog      128
#define iSound            4
#define iFullScreen       5
#define iAutoScroll       6
#define rStringList       128
#define iPrefsFileName    1
#define rTypePrefs        'PrFn'
#define kPrefsID          128
#define rTypeWinSizePos   'WiSp'
#define kWinSizePosID     128
#define rPageFormat       'PgFt'
#define kPageFormatID     128
#define rTypeAppMiss      'STR '
#define kAppMissID        -16397
#define topLeft(r)        (((Point *) &(r))[0])
#define botRight(r)       (((Point *) &(r))[1])

// ..... typedefs

typedef struct
{
    Boolean sound;
    Boolean fullScreen;
    Boolean autoScroll;
    SInt16 programRunCount;
} appPrefs, **appPrefsHandle;

```

```

typedef struct
{
    Rect windowRect;
} windowSizePos, **windowSizePosHandle;

typedef struct
{
    Handle pageFormatHdl;
    FSSpec fileFSSpec;
} docStructure, **docStructureHandle;

// ..... global variables

Boolean      gRunningOnX = false;
PMPrintSession gPrintSession;
WindowRef     gWindowRef;
SInt16        gAppResFileRefNum;
Boolean       gSoundPref;
Boolean       gFullScreenPref;
Boolean       gAutoScrollPref;
SInt16        gProgramRunCountPref;
Boolean       gSoundCFPref;
Boolean       gFullScreenCFPref;
Boolean       gAutoScrollCFPref;
SInt16        gProgramRunCountCFPref;
Boolean       gWindowOpen      = false;
Boolean       gPageFormatChanged = false;
SInt16        gPrefsFileRefNum  = 0;

// ..... function prototypes

void      main                (void);
void      doPreliminaries     (void);
OSStatus  appEventHandler     (EventHandlerCallRef,EventRef,void *);
OSStatus  windowEventHandler  (EventHandlerCallRef,EventRef,void *);
void      doDrawContent       (WindowRef);
void      doAdjustMenus       (void);
void      doMenuChoice        (MenuID,MenuItemIndex);
void      doErrorAlert        (SInt16);
void      doOpenCommand       (void);
void      navEventFunction     (NavEventCallbackMessage,NavCRecPtr,
                               NavCallBackUserData);
void      doOpenWindow        (FSSpec);
void      doCloseWindow       (void);
void      doPreferencesDialog  (void);
OSStatus  doPageSetupDialog    (void);
void      doGetPreferencesResource (void);
void      doGetPreferencesCFPrefs (void);
OSError   doCopyResource       (ResType,SInt16,SInt16,SInt16);
void      doSavePreferencesResource (void);
void      doSavePreferencesCFPrefs (void);
void      doLoadAndSetWindowSizeAndPosition (WindowRef);
void      doGetFrameWidthAndTitleBarHeight (WindowRef,SInt16 *,SInt16 *);
void      doSaveWindowSizeAndPosition (WindowRef);
void      doGetPageFormat      (WindowRef);
void      doSavePageFormat     (WindowRef);

```



```
// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;
    MenuRef        menuRef;
    OSStatus       osStatus;
    EventTypeSpec  applicationEvents[] = { { kEventClassCommand, kEventProcessCommand },
                                           { kEventClassMenu,    kEventMenuEnableItems } };

    // ..... do preliminaries

    doPreliminaries();

    // ..... set current resource file to application resource fork

    gAppResFileRefNum = CurResFile();

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMenubar);
    if(menubarHdl == NULL)
        doErrorAlert(MemError());
    SetMenuBar(menubarHdl);
    DrawMenuBar();

    Gestalt(gestaltMenuMgrAttr,&response);
    if(response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
        {
            DeleteMenuItem(menuRef,iQuit);
            DeleteMenuItem(menuRef,iQuit - 1);
        }
        menuRef = GetMenuRef(mEdit);
        if(menuRef != NULL)
        {
            DeleteMenuItem(menuRef,iPreferences);
            DeleteMenuItem(menuRef,iPreferences - 1);
            DisableMenuItem(menuRef,0);
        }

        EnableMenuCommand(NULL,kHICCommandPreferences);

        gRunningOnX = true;
    }
    else
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
            SetMenuItemCommandID(menuRef,iQuit,kHICCommandQuit);
    }
}
```

```

    menuRef = GetMenuRef(mEdit);
    if(menuRef != NULL)
        SetMenuItemCommandID(menuRef,iPreferences,kHICommandPreferences);
}

// ..... create printing session

osStatus = PMCreateSession(&gPrintSession);
if(osStatus != kPMNoError)
    doErrorAlert(osStatus);

// ..... read in application preferences and increment program run count

doGetPreferencesResource();
doGetPreferencesCFPrefs();

gProgramRunCountPref++;
gProgramRunCountCFPref++;

// ..... install application event handler

InstallApplicationEventHandler(NewEventHandlerUPP((EventHandlerProcPtr) appEventHandler),
                             GetEventTypeCount(applicationEvents),applicationEvents,
                             0,NULL);

// ..... run application event loop

RunApplicationEventLoop();
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(320);
    InitCursor();
}

// ***** appEventHandler

OSStatus appEventHandler(EventHandlerCallRef eventHandlerCallRef,EventRef eventRef,
                        void * userData)
{
    OSStatus    result = eventNotHandledErr;
    UInt32      eventClass;
    UInt32      eventKind;
    HICommand    hiCommand;
    MenuID       menuID;
    MenuItemIndex menuItem;

    eventClass = GetEventClass(eventRef);
    eventKind  = GetEventKind(eventRef);

```

```

switch(eventClass)
{
    case kEventClassCommand:
        if(eventKind == kEventProcessCommand)
        {
            GetEventParameter(eventRef,kEventParamDirectObject,typeHICCommand,NULL,
                              sizeof(HICCommand),NULL,&hiCommand);
            menuID = GetMenuID(hiCommand.menu.menuRef);
            menuItem = hiCommand.menu.menuItemIndex;
            if(hiCommand.commandID == kHICCommandPreferences)
            {
                doPreferencesDialog();
                result = noErr;
            }
            else if(hiCommand.commandID == kHICCommandQuit)
            {
                while(FrontWindow())
                    doCloseWindow();
                PMRelease(&gPrintSession);
                doSavePreferencesResource();
                doSavePreferencesCFPrefs();
            }
            else if((menuID >= mAppleApplication && menuID <= mEdit))
            {
                doMenuChoice(menuID,menuItem);
                result = noErr;
            }
        }
        break;

    case kEventClassMenu:
        if(eventKind == kEventMenuEnableItems)
        {
            doAdjustMenus();
            result = noErr;
        }
        break;
}

return result;
}

// ***** windowEventHandler

OSStatus windowEventHandler(EventHandlerCallRef eventHandlerCallRef,EventRef eventRef,
                           void* userData)
{
    OSStatus result = eventNotHandledErr;
    UInt32 eventClass;
    UInt32 eventKind;
    WindowRef windowRef;
    Rect mainScreenRect;
    BitMap screenBits;
    Point idealHeightAndWidth, minimumHeightAndWidth;

```

```

eventClass = GetEventClass(eventRef);
eventKind = GetEventKind(eventRef);

switch(eventClass)
{
    case kEventClassWindow:
        GetEventParameter(eventRef, kEventParamDirectObject, typeWindowRef, NULL, sizeof(windowRef),
                           NULL, &windowRef);
        switch(eventKind)
        {
            case kEventWindowDrawContent:
                doDrawContent(windowRef);
                result = noErr;
                break;

            case kEventWindowGetIdealSize:
                mainScreenRect = GetQDGlobalsScreenBits(&screenBits)->bounds;
                idealHeightAndWidth.v = mainScreenRect.bottom - 75;
                idealHeightAndWidth.h = 600;
                SetEventParameter(eventRef, kEventParamDimensions, typeQDPoint,
                                 sizeof(idealHeightAndWidth), &idealHeightAndWidth);

                result = noErr;
                break;

            case kEventWindowGetMinimumSize:
                minimumHeightAndWidth.v = 190;
                minimumHeightAndWidth.h = 400;
                SetEventParameter(eventRef, kEventParamDimensions, typeQDPoint,
                                 sizeof(minimumHeightAndWidth), &minimumHeightAndWidth);

                result = noErr;
                break;

            case kEventWindowClose:
                doCloseWindow();
                result = noErr;
                break;
        }
        break;
}

return result;
}

// ***** doDrawContent

void doDrawContent(WindowRef windowRef)
{
    RGBColor      whiteColor = { 0xFFFF, 0xFFFF, 0xFFFF };
    RGBColor      blueColor  = { 0x1818, 0x4B4B, 0x8181 };
    Rect          portRect;
    docStructureHandle docStrucHdl;
    PMPPageFormat pageFormat = kPMNoPageFormat;
    Str255        string;
    PMResolution  resolution;
    PMRect        paperRect;
    PMRect        pageRect;
    UInt16        orientation;

```

```

    RGBForeColor(&whiteColor);
    RGBBackColor(&blueColor);
    GetWindowPortBounds(windowRef,&portRect);
    EraseRect(&portRect);

    SetPortWindowPort(windowRef);

    MoveTo(10,20);
    TextFace(bold);
    DrawString("\pApplication Preferences:");
    MoveTo(10,35);
    DrawString("\pResource Fork Prefs File");
    MoveTo(170,35);
    DrawString("\pCF Preferences Services");
    TextFace(normal);
    MoveTo(10,50);
    DrawString("\pSound On: ");
    if(gSoundPref) DrawString("\pYES");
    else DrawString("\pNO");
    MoveTo(10,65);
    DrawString("\pFull Screen On: ");
    if(gFullScreenPref) DrawString("\pYES");
    else DrawString("\pNO");
    MoveTo(10,80);
    DrawString("\pAutoScroll On: ");
    if(gAutoScrollPref) DrawString("\pYES");
    else DrawString("\pNO");
    MoveTo(10,95);
    DrawString("\pProgram run count: ");
    NumToString((SInt32) gProgramRunCountPref,string);
    DrawString(string);

    MoveTo(170,50);
    DrawString("\pSound On: ");
    if(gSoundCFPref) DrawString("\pYES");
    else DrawString("\pNO");
    MoveTo(170,65);
    DrawString("\pFull Screen On: ");
    if(gFullScreenCFPref) DrawString("\pYES");
    else DrawString("\pNO");
    MoveTo(170,80);
    DrawString("\pAutoScroll On: ");
    if(gAutoScrollCFPref) DrawString("\pYES");
    else DrawString("\pNO");
    MoveTo(170,95);
    DrawString("\pProgram run count: ");
    NumToString((SInt32) gProgramRunCountCFPref,string);
    DrawString(string);

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    PMUnflattenPageFormat((*docStrucHdl)->pageFormatHdl,&pageFormat);
    PMGetResolution(pageFormat,&resolution);
    PMGetAdjustedPaperRect(pageFormat,&paperRect);
    PMGetAdjustedPageRect(pageFormat,&pageRect);

```

```

PMGetOrientation(pageFormat,&orientation);
if(pageFormat != kPMNoPageFormat)
    PMRelease(&pageFormat);

MoveTo(10,115);
TextFace(bold);
DrawString("\pInformation From Document's 'PgFt' (Page Format) Resource:");
TextFace(normal);

if((*docStrucHdl)->pageFormatHdl != NULL)
{
    MoveTo(10,130);
    DrawString("\pApplication's Drawing Resolution: ");
    NumToString((long) resolution.hRes,string);
    DrawString(string);
    DrawString("\p dpi horizontal, ");
    NumToString((long) resolution.vRes,string);
    DrawString(string);
    DrawString("\p dpi vertical");

    MoveTo(10,145);
    DrawString("\pPaper Rectangle Size in Drawing Resolution: ");
    NumToString((long) (paperRect.bottom - paperRect.top),string);
    DrawString(string);
    DrawString("\p by ");
    NumToString((long) (paperRect.right - paperRect.left),string);
    DrawString(string);

    MoveTo(10,160);
    DrawString("\pPage Rectangle Size in Drawing Resolution: ");
    NumToString((long) (pageRect.bottom - pageRect.top),string);
    DrawString(string);
    DrawString("\p by ");
    NumToString((long) (pageRect.right - pageRect.left),string);
    DrawString(string);

    MoveTo(10,175);
    DrawString("\pOrientation: ");
    if(orientation == 1)
        DrawString("\pPortrait");
    else if(orientation == 2)
        DrawString("\pLandscape");
}
else
{
    MoveTo(10,130);
    DrawString("\pA page format ('PgFt') resource has not been saved yet.");
    MoveTo(10,145);
    DrawString("\pOpen the Page Setup... dialog before closing the window or quitting.");
}

QDFlushPortBuffer(GetWindowPort(gWindowRef),NULL);
}

```

```
// ***** doAdjustMenu
```

```
void doAdjustMenu(void)
{
    MenuRef menuRef;

    if(gWindowOpen)
    {
        menuRef = GetMenuRef(mFile);
        DisableMenuItem(menuRef,iOpen);
        EnableMenuItem(menuRef,iClose);
        EnableMenuItem(menuRef,iPageSetup);
    }
    else
    {
        menuRef = GetMenuRef(mFile);
        EnableMenuItem(menuRef,iOpen);
        DisableMenuItem(menuRef,iClose);
        DisableMenuItem(menuRef,iPageSetup);
    }

    DrawMenuBar();
}

// ***** doMenuChoice
```

```
void doMenuChoice(MenuID menuID,MenuItemIndex menuItem)
{
    OSStatus osStatus;
    Rect portRect;

    if(menuID == 0)
        return;

    switch(menuID)
    {
    case mAppleApplication:
        if(menuItem == iAbout)
            SysBeep(10);
        break;

    case mFile:
        switch(menuItem)
        {
        case iClose:
            doCloseWindow();
            break;

        case iOpen:
            doOpenCommand();
            break;
```

```

    case iPageSetup:
        osStatus = doPageSetupDialog();
        if(osStatus != kPMNoError && osStatus != kPMCancel)
            doErrorAlert(osStatus);
        if(FrontWindow())
        {
            GetWindowPortBounds(FrontWindow(),&portRect);
            InvalWindowRect(FrontWindow(),&portRect);
        }
        break;
    }
    break;
}
}

// ***** doErrorAlert

void doErrorAlert(SInt16 errorCode)
{
    Str255 errorString;
    SInt16 itemHit;

    NumToString((SInt32) errorCode,errorString);

    if(errorCode != memFullErr)
        StandardAlert(kAlertCautionAlert,errorString,NULL,NULL,&itemHit);
    else
    {
        StandardAlert(kAlertStopAlert,errorString,NULL,NULL,&itemHit);
        ExitToShell();
    }
}

// ***** doOpenCommand

void doOpenCommand(void)
{
    OSErr          osError = noErr;
    NavDialogOptions dialogOptions;
    NavEventUPP     navEventFunctionUPP;
    NavReplyRecord   navReplyStruc;
    SInt32           index, count;
    AEKeyword        theKeyword;
    DescType         actualType;
    FSSpec           fileSpec;
    Size             actualSize;

    osError = NavGetDefaultDialogOptions(&dialogOptions);

    if(osError == noErr)
    {
        navEventFunctionUPP = NewNavEventUPP((NavEventProcPtr) navEventFunction);
        osError = NavGetFile(NULL,&navReplyStruc,&dialogOptions,navEventFunctionUPP,NULL,NULL,
                               NULL,NULL);
        DisposeNavEventUPP(navEventFunctionUPP);
    }
}

```



```

    if(osError == noErr && navReplyStruc.validRecord)
    {
        osError = AECountItems(&(navReplyStruc.selection),&count);
        if(osError == noErr)
        {
            for(index=1;index<=count;index++)
            {
                osError = AEGetNthPtr(&(navReplyStruc.selection),index,typeFSS,&theKeyword,
                                     &actualType,&fileSpec,sizeof(fileSpec),&actualSize);

                doOpenWindow(fileSpec);
            }
        }

        NavDisposeReply(&navReplyStruc);
    }
}

// ***** navEventFunction

void navEventFunction(NavEventCallbackMessage callBackSelector,NavCBRecPtr callBackParms,
                     NavCallBackUserData callBackUD)
{
}

// ***** doOpenWindow

void doOpenWindow(FSSpec fileSpec)
{
    OSStatus      osError;
    docStructureHandle docStrucHdl;
    Rect          contentRect = { 100,100,290,500 };
    WindowAttributes attributes = { kWindowStandardHandlerAttribute |
                                    kWindowStandardDocumentAttributes };
    EventTypeSpec windowEvents[] = { { kEventClassWindow, kEventWindowDrawContent },
                                      { kEventClassWindow, kEventWindowGetIdealSize },
                                      { kEventClassWindow, kEventWindowGetMinimumSize },
                                      { kEventClassWindow, kEventWindowClose } };

    osError = CreateNewWindow(kDocumentWindowClass,attributes,&contentRect,&gWindowRef);
    if(osError != noErr)
        QuitApplicationEventLoop();

    if(!(docStrucHdl = (docStructureHandle) NewHandle(sizeof(docStructure))))
    {
        DisposeWindow(gWindowRef);
        QuitApplicationEventLoop();
    }

    SetWRefCon(gWindowRef,(SInt32) docStrucHdl);
    (*docStrucHdl)->fileFSSpec = fileSpec;
    SetWTitle(gWindowRef,(*docStrucHdl)->fileFSSpec.name);
    (*docStrucHdl)->pageFormatHdl = NULL;
}

```

```

SetPortWindowPort(gWindowRef);
UseThemeFont(kThemeSmallSystemFont,smSystemScript);

InstallWindowEventHandler(gWindowRef,
                          NewEventHandlerUPP((EventHandlerProcPtr) windowEventHandler),
                          GetEventTypeCount(windowEvents),windowEvents,0,NULL);

doLoadAndSetWindowSizeAndPosition(gWindowRef);
doGetPageFormat(gWindowRef);
ShowWindow(gWindowRef);
gWindowOpen = true;
}

// ***** doCloseWindow

void doCloseWindow(void)
{
    WindowRef      windowRef;
    docStructureHandle docStrucHdl;
    OSErr          osError = 0;

    windowRef = FrontWindow();
    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

    doSaveWindowSizeAndPosition(windowRef);

    if(gPageFormatChanged)
        doSavePageFormat(windowRef);

    DisposeHandle((Handle) docStrucHdl);
    DisposeWindow(windowRef);
    gWindowOpen = false;
}

// ***** doPreferencesDialog

void doPreferencesDialog(void)
{
    DialogRef modalDlgRef;
    ControlRef controlHdl;
    SInt16 itemHit;
    Rect portRect;

    if(!(modalDlgRef = GetNewDialog(rPrefsDialog,NULL,(WindowRef) -1)))
        return;

    SetDialogDefaultItem(modalDlgRef,kStdOkItemIndex);
    SetDialogCancelItem(modalDlgRef,kStdCancelItemIndex);

    GetDialogItemAsControl(modalDlgRef,iSound,&controlHdl);
    SetControlValue(controlHdl,gSoundPref);
    GetDialogItemAsControl(modalDlgRef,iFullScreen,&controlHdl);
    SetControlValue(controlHdl,gFullScreenPref);
    GetDialogItemAsControl(modalDlgRef,iAutoScroll,&controlHdl);
    SetControlValue(controlHdl,gAutoScrollPref);

```

```

ShowWindow(GetDialogWindow(modalDlgRef));

do
{
    ModalDialog(NULL,&itemHit);
    GetDialogItemAsControl(modalDlgRef,itemHit,&controlHdl);
    SetControlValue(controlHdl,!GetControlValue(controlHdl));
} while((itemHit != kStdOkItemIndex) && (itemHit != kStdCancelItemIndex));

if(itemHit == kStdOkItemIndex)
{
    GetDialogItemAsControl(modalDlgRef,iSound,&controlHdl);
    gSoundPref = gSoundCFPref = GetControlValue(controlHdl);
    GetDialogItemAsControl(modalDlgRef,iFullScreen,&controlHdl);
    gFullScreenPref = gFullScreenCFPref = GetControlValue(controlHdl);
    GetDialogItemAsControl(modalDlgRef,iAutoScroll,&controlHdl);
    gAutoScrollPref = gAutoScrollCFPref = GetControlValue(controlHdl);
}

DisposeDialog(modalDlgRef);

if(gWindowRef)
{
    GetWindowPortBounds(gWindowRef,&portRect);
    InvalWindowRect(gWindowRef,&portRect);
}

doSavePreferencesResource();
doSavePreferencesCFPrefs();
}

// ***** doPageSetupDialog

OSStatus doPageSetupDialog(void)
{
    docStructureHandle docStrucHdl;
    OSStatus           osStatus   = kPMNoError;
    PMPageFormat       pageFormat = kPMNoPageFormat;
    Boolean             userClickedOKButton;

    docStrucHdl = (docStructureHandle) GetWRefCon(gWindowRef);
    HLock((Handle) docStrucHdl);

    if ((*docStrucHdl)->pageFormatHdl == NULL)
    {
        osStatus = PMCreatePageFormat(&pageFormat);
        if((osStatus == kPMNoError) && (pageFormat != kPMNoPageFormat))
            osStatus = PMSessionDefaultPageFormat(gPrintSession,pageFormat);
        if(osStatus == kPMNoError)
            osStatus = PMFlattenPageFormat(pageFormat,&(*docStrucHdl)->pageFormatHdl);
    }
    else
    {
        osStatus = PMUnflattenPageFormat((*docStrucHdl)->pageFormatHdl,&pageFormat);
        if(osStatus == kPMNoError)
            osStatus = PMSessionValidatePageFormat(gPrintSession,pageFormat,kPMWantBoolean);
    }
}

```

```

if((osStatus == kPMNoError) && (pageFormat != kPMNoPageFormat))
{
    SetThemeCursor(kThemeArrowCursor);

    osStatus = PMSessionPageSetupDialog(gPrintSession,pageFormat,&userClickedOKButton);
    if(!userClickedOKButton)
        osStatus = kPMCancel;
}

if(osStatus == kPMNoError && userClickedOKButton)
{
    DisposeHandle((*docStrucHdl)->pageFormatHdl);
    (*docStrucHdl)->pageFormatHdl = NULL;
    osStatus = PMFlattenPageFormat(pageFormat,&(*docStrucHdl)->pageFormatHdl);

    gPageFormatChanged = true;
}

if(pageFormat != kPMNoPageFormat)
    PMRelease(&pageFormat);

HUnlock((Handle) docStrucHdl);

return osStatus;
}

// ***** doGetPreferencesResource

void doGetPreferencesResource(void)
{
    Str255      prefsFileName;
    OSErr       osError;
    SInt16      volRefNum;
    long        directoryID;
    FSSpec      fileSSpec;
    SInt16      fileRefNum;
    appPrefsHandle appPrefsHdl;

    GetIndString(prefsFileName,rStringList,iPrefsFileName);

    osError = FindFolder(kUserDomain,kPreferencesFolderType,kDontCreateFolder,&volRefNum,
        &directoryID);
    if(osError == noErr)
        osError = FSMakeFSSpec(volRefNum,directoryID,prefsFileName,&fileSSpec);
    if(osError == noErr || osError == fnfErr)
        fileRefNum = FSpOpenResFile(&fileSSpec,fsCurPerm);

    if(fileRefNum == -1)
    {
        FSpCreateResFile(&fileSSpec,'PpPp','pref',smSystemScript);
        osError = ResError();

        if(osError == noErr)
        {
            fileRefNum = FSpOpenResFile(&fileSSpec,fsCurPerm);
            if(fileRefNum != -1 )
            {
                UseResFile(gAppResFileRefNum);
            }
        }
    }
}

```

```

        osError = doCopyResource(rTypePrefs,kPrefsID,gAppResFileRefNum,fileRefNum);
        if(osError == noErr)
            osError = doCopyResource(rTypeAppMiss,kAppMissID,gAppResFileRefNum,fileRefNum);
        if(osError != noErr)
        {
            CloseResFile(fileRefNum);
            osError = FSpDelete(&fileSSpec);
            fileRefNum = -1;
        }
    }
}

if(fileRefNum != -1)
{
    UseResFile(fileRefNum);

    appPrefsHdl = (appPrefsHandle) Get1Resource(rTypePrefs,kPrefsID);
    if(appPrefsHdl == NULL)
        return;

    gSoundPref = (*appPrefsHdl)->sound;
    gFullScreenPref = (*appPrefsHdl)->fullScreen;
    gAutoScrollPref = (*appPrefsHdl)->autoScroll;
    gProgramRunCountPref = (*appPrefsHdl)->programRunCount;

    gPrefsFileRefNum = fileRefNum;

    UseResFile(gAppResFileRefNum);
}

// ***** doGetPreferencesCFPrefs

void doGetPreferencesCFPrefs(void)
{
    CFStringRef applicationID9 = CFSTR("MoreResources CFPrefs");
    CFStringRef applicationIDX = CFSTR("com.Windmill.MoreResources");
    CFStringRef applicationID;
    CFStringRef soundOnKey = CFSTR("sound");
    CFStringRef fullScreenKey = CFSTR("fullScreen");
    CFStringRef autoScrollKey = CFSTR("autoScroll");
    CFStringRef runCountKey = CFSTR("runCount");
    Boolean booleanValue, success;

    if(gRunningOnX)
        applicationID = applicationIDX;
    else
        applicationID = applicationID9;

    booleanValue = CFPreferencesGetAppBooleanValue(soundOnKey,applicationID,&success);
    if(success)
        gSoundCFPref = booleanValue;
    else

```

```

{
    gSoundCFPref      = true;
    gFullScreenCFPref = true;
    gAutoScrollCFPref = true;
    doSavePreferencesCFPrefs();
    return;
}

booleanValue = CFPreferencesGetAppBooleanValue(fullScreenKey,applicationID,&success);
if(success)
    gFullScreenCFPref = booleanValue;

booleanValue = CFPreferencesGetAppBooleanValue(autoScrollKey,applicationID,&success);
if(success)
    gAutoScrollCFPref = booleanValue;

gProgramRunCountCFPref = CFPreferencesGetAppIntegerValue(runCountKey,applicationID,
                                                         &success);
}

// ***** doCopyResource

OSErr doCopyResource(ResType resType,SInt16 resID,SInt16 sourceFileRefNum,
                    SInt16 destFileRefNum)
{
    SInt16 oldResFileRefNum;
    Handle sourceResourceHdl;
    ResType ignoredType;
    SInt16 ignoredID;
    Str255 resourceName;
    SInt16 resAttributes;
    OSErr osError;

    oldResFileRefNum = CurResFile();
    UseResFile(sourceFileRefNum);

    sourceResourceHdl = Get1Resource(resType,resID);

    if(sourceResourceHdl != NULL)
    {
        GetResInfo(sourceResourceHdl,&ignoredID,&ignoredType,resourceName);
        resAttributes = GetResAttrs(sourceResourceHdl);
        DetachResource(sourceResourceHdl);
        UseResFile(destFileRefNum);
        if(ResError() == noErr)
            AddResource(sourceResourceHdl,resType,resID,resourceName);
        if(ResError() == noErr)
            SetResAttrs(sourceResourceHdl,resAttributes);
        if(ResError() == noErr)
            ChangedResource(sourceResourceHdl);
        if(ResError() == noErr)
            WriteResource(sourceResourceHdl);
    }
}

```

```

    osError = ResError();

    ReleaseResource(sourceResourceHdl);
    UseResFile(oldResFileRefNum);

    return osError;
}

// ***** doSavePreferencesResource

void doSavePreferencesResource(void)
{
    SInt16          currentResFile;
    appPrefsHandle  appPrefsHdl;
    Handle          existingResHdl;
    Str255          resourceName = "\pPreferences";

    if(gPrefsFileRefNum == -1)
        return;

    currentResFile = CurResFile();

    appPrefsHdl = (appPrefsHandle) NewHandleClear(sizeof(appPrefs));

    HLock((Handle) appPrefsHdl);

    (*appPrefsHdl)->sound = gSoundPref;
    (*appPrefsHdl)->fullScreen = gFullScreenPref;
    (*appPrefsHdl)->autoScroll = gAutoScrollPref;
    (*appPrefsHdl)->programRunCount = gProgramRunCountPref;

    UseResFile(gPrefsFileRefNum);

    existingResHdl = Get1Resource(rTypePrefs,kPrefsID);

    if(existingResHdl != NULL)
    {
        RemoveResource(existingResHdl);
        DisposeHandle(existingResHdl);
        if(ResError() == noErr)
            AddResource((Handle) appPrefsHdl,rTypePrefs,kPrefsID,resourceName);
        if(ResError() == noErr)
            WriteResource((Handle) appPrefsHdl);
    }

    HUnlock((Handle) appPrefsHdl);

    ReleaseResource((Handle) appPrefsHdl);
    UseResFile(currentResFile);
}

```

```
// ***** doSavePreferencesCFPrefs
```

```
void doSavePreferencesCFPrefs(void)
{
    CFStringRef applicationID9 = CFSTR("MoreResources CFPrefs");
    CFStringRef applicationIDX = CFSTR("com.Windmill.MoreResources");
    CFStringRef applicationID;
    CFStringRef soundOnKey = CFSTR("sound");
    CFStringRef fullScreenKey = CFSTR("fullScreen");
    CFStringRef autoScrollKey = CFSTR("autoScroll");
    CFStringRef yes = CFSTR("yes");
    CFStringRef no = CFSTR("no");
    CFStringRef runCountKey = CFSTR("runCount");
    Str255 runCountPascalString;
    CFStringRef runCountCFString;

    if(gRunningOnX)
        applicationID = applicationIDX;
    else
        applicationID = applicationID9;

    if(gSoundCFPref)
        CFPreferencesSetAppValue(soundOnKey, yes, applicationID);
    else
        CFPreferencesSetAppValue(soundOnKey, no, applicationID);

    if(gFullScreenCFPref)
        CFPreferencesSetAppValue(fullScreenKey, yes, applicationID);
    else
        CFPreferencesSetAppValue(fullScreenKey, no, applicationID);

    if(gAutoScrollCFPref)
        CFPreferencesSetAppValue(autoScrollKey, yes, applicationID);
    else
        CFPreferencesSetAppValue(autoScrollKey, no, applicationID);

    NumToString((SInt32) gProgramRunCountCFPref, runCountPascalString);
    runCountCFString = CFStringCreateWithPascalString(NULL, runCountPascalString,
                                                    CFStringGetSystemEncoding());
    CFPreferencesSetAppValue(runCountKey, runCountCFString, applicationID);

    CFPreferencesAppSynchronize(applicationID);

    if(runCountCFString != NULL)
        CFRelease(runCountCFString);
}
```



```
// ***** doLoadAndSetWindowSizeAndPosition

void doLoadAndSetWindowSizeAndPosition(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    SInt16 fileRefNum;
    OSErr osError;
    windowSizePosHandle windowSizePosHdl;
    Rect windowRect;
    SInt16 frameWidth, titleBarHeight, menuBarHeight;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    fileRefNum = FSpOpenResFile(&(*docStrucHdl)->fileFSSpec,fsRdWrPerm);
    if(fileRefNum < 0)
    {
        osError = ResError();
        doErrorAlert(osError);
        return;
    }

    windowSizePosHdl = (windowSizePosHandle) Get1Resource(rTypeWinSizePos,kWinSizePosID);

    if(windowSizePosHdl != NULL )
    {
        windowRect = (*windowSizePosHdl)->windowRect;
    }
    else
    {
        doGetFrameWidthAndTitleBarHeight(windowRef,&frameWidth,&titleBarHeight);
        GetThemeMenuBarHeight(&menuBarHeight);
        SetRect(&windowRect,frameWidth + 1,titleBarHeight + menuBarHeight + 1,
            frameWidth + 400,titleBarHeight + menuBarHeight + 190);
    }

    MoveWindow(windowRef,windowRect.left,windowRect.top,false);
    SizeWindow(windowRef,windowRect.right - windowRect.left,windowRect.bottom - windowRect.top,
        true);

    ReleaseResource((Handle) windowSizePosHdl);
    CloseResFile(fileRefNum);
}

// ***** doGetFrameWidthAndTitleBarHeight

void doGetFrameWidthAndTitleBarHeight(WindowRef windowRef,SInt16 *frameWidth,
    SInt16 *titleBarHeight)
{
    RgnHandle structureRegionHdl = NewRgn();
    RgnHandle contentRegionHdl = NewRgn();
    Rect structureRect, contentRect;

    GetWindowRegion(windowRef,kWindowStructureRgn,structureRegionHdl);
    GetRegionBounds(structureRegionHdl,&structureRect);
    GetWindowRegion(windowRef,kWindowContentRgn,contentRegionHdl);
    GetRegionBounds(contentRegionHdl,&contentRect);
}
```

```

*frameWidth = contentRect.left - structureRect.left - 1;
*titleBarHeight = contentRect.top - structureRect.top - 1;

DisposeRgn(structureRegionHdl);
DisposeRgn(contentRegionHdl);
}

// ***** doSaveWindowSizeAndPosition

void doSaveWindowSizeAndPosition(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    Rect                portRect;
    SInt16              fileRefNum;
    OSErr               osError;
    windowSizePos       windowSizePosStruct;
    windowSizePosHandle windowSizePosHdl;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    fileRefNum = FSpOpenResFile(&(*docStrucHdl)->fileFSSpec, fsRdWrPerm);
    if(fileRefNum < 0)
    {
        osError = ResError();
        doErrorAlert(osError);
        return;
    }

    GetWindowPortBounds(windowRef, &portRect);
    SetPortWindowPort(windowRef);
    LocalToGlobal(&topLeft(portRect));
    LocalToGlobal(&botRight(portRect));
    windowSizePosStruct.windowRect = portRect;

    windowSizePosHdl = (windowSizePosHandle) Get1Resource(rTypeWinSizePos, kWinSizePosID);
    if(windowSizePosHdl != NULL)
    {
        **windowSizePosHdl = windowSizePosStruct;
        ChangedResource((Handle) windowSizePosHdl);
        osError = ResError();
        if(osError != noErr)
            doErrorAlert(osError);
    }
    else
    {
        windowSizePosHdl = (windowSizePosHandle) NewHandle(sizeof(windowSizePos));
        if(windowSizePosHdl != NULL)
        {
            **windowSizePosHdl = windowSizePosStruct;
            AddResource((Handle) windowSizePosHdl, rTypeWinSizePos, kWinSizePosID,
                "\pLast window size and position");
        }
    }
}

```

```

    if(windowSizePosHdl != NULL)
    {
        UpdateResFile(fileRefNum);
        osError = ResError();
        if(osError != noErr)
            doErrorAlert(osError);

        ReleaseResource((Handle) windowSizePosHdl);
    }

    CloseResFile(fileRefNum);
}

// ***** doGetPageFormat

void doGetPageFormat(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    SInt16             fileRefNum;
    OSErr              osError;
    Handle             pageFormatResourceHdl = NULL;
    PMPageFormat       pageFormat = kPMNoPageFormat;
    Boolean            settingsChanged;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    HLock((Handle) docStrucHdl);

    fileRefNum = FSpOpenResFile(&(*docStrucHdl)->fileFSSpec,fsRdWrPerm);
    if(fileRefNum < 0)
    {
        osError = ResError();
        doErrorAlert(osError);
        return;
    }

    pageFormatResourceHdl = Get1Resource(rPageFormat,kPageFormatID);

    if(pageFormatResourceHdl != NULL)
    {
        PMUnflattenPageFormat(pageFormatResourceHdl,&pageFormat);
        PMSessionValidatePageFormat(gPrintSession,pageFormat,&settingsChanged);

        DisposeHandle((*docStrucHdl)->pageFormatHdl);
        PMFlattenPageFormat(pageFormat,&((*docStrucHdl)->pageFormatHdl));

        if(pageFormat != kPMNoPageFormat)
            PMRelease(&pageFormat);
        ReleaseResource(pageFormatResourceHdl);
    }

    CloseResFile(fileRefNum);

    HUnlock((Handle) docStrucHdl);
}

```

```
// ***** doSavePageFormat
```

```
void doSavePageFormat(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    Handle              pageFormatHdl;
    SInt16              fileRefNum;
    OSErr               osError;
    Size                handleSize;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    handleSize = GetHandleSize((*docStrucHdl)->pageFormatHdl);

    fileRefNum = FSpOpenResFile(&(*docStrucHdl)->fileFSSpec,fsRdWrPerm);
    if(fileRefNum < 0)
    {
        osError = ResError();
        doErrorAlert(osError);
        return;
    }

    pageFormatHdl = Get1Resource(rPageFormat,kPageFormatID);

    if(pageFormatHdl != NULL)
    {
        RemoveResource(pageFormatHdl);
        DisposeHandle(pageFormatHdl);
        pageFormatHdl = NewHandle(handleSize);
        BlockMove((*docStrucHdl)->pageFormatHdl,*pageFormatHdl,handleSize);
        AddResource(pageFormatHdl,rPageFormat,kPageFormatID,"pPage Format");
        osError = ResError();
        if(osError != noErr)
            doErrorAlert(osError);
    }
    else
    {
        pageFormatHdl = NewHandle(handleSize);
        if(pageFormatHdl != NULL)
        {
            BlockMove((*docStrucHdl)->pageFormatHdl,*pageFormatHdl,handleSize);
            AddResource(pageFormatHdl,rPageFormat,kPageFormatID,"pPage Format");
            osError = ResError();
            if(osError != noErr)
                doErrorAlert(osError);
        }
    }

    if(pageFormatHdl != NULL)
    {
        UpdateResFile(fileRefNum);
        osError = ResError();
        if(osError != noErr)
            doErrorAlert(osError);
    }
}
```

```

        ReleaseResource(pageFormatHdl);
    }

    gPageFormatChanged = false;

    CloseResFile(fileRefNum);
}

// *****

```

## Demonstration Program MoreResources Comments

This program uses two methods for saving and retrieving application preferences. The first method involves a custom preferences ('PrFn') resource, which is saved to the resource fork of a preferences file named MoreResources Preferences. The second method involves the use of Core Foundation Preferences Services, which creates and saves preferences to a file named com.Windmill.MoreResources.plist on Mac OS X and MoreResources CFPrefs.plist on Mac OS 8/9. These files are created when the program is first run. Thereafter, the preferences will be read in from the preferences files every time the program is run and replaced whenever the user invokes the Preferences dialog to change the preferences settings.

When the application is first run, an “application missing” 'STR' resource is also copied to the resource fork of the preferences file created by the first method. On Mac OS 8/9, if the user double-clicks on the icon for this preferences file, an alert is invoked displaying the text contained in the “application missing” resource.

After the program is launched, the user should choose Open from the File menu to open the included demonstration document file (titled “MoreResources Document”). The resource fork of this file contains two custom resources, namely, a 'WiSp' resource containing the last saved window user state and zoom state, and a 'PgFt' resource containing a flattened PMPageFormat object. These two resources are read in whenever the document file is opened. The 'WiSp' resource is written to whenever the file is closed. The 'PgFt' resource is written to when the file is closed only if the user invoked the Page Setup dialog while the document was open.

No data is read in from the document's data fork. Instead, the window is used to display the current preferences settings and information extracted from the document's 'PgFt' resource. This is simply to keep the code not directly related to resources to a minimum.

The user should choose different paper size, scaling, and orientation settings in the Page Setup dialog, resize or zoom the window, close the file, reopen the file, and note that, the saved page format values are correctly retrieved and the window is reopened in the size and position in which it was closed. The user should also change the application preferences settings via the Preferences dialog (which is invoked when the Preference item in the Mac OS 8/9 Edit menu or Mac OS X Application menu is chosen), quit the program, relaunch the program, and note that the last saved preferences settings are retrieved at program launch.

The user may also care to remove the 'WiSp' and 'PgFt' resources from the document file's resource fork, run the program, force a 'PgFt' resource to be created and written to by invoking the Page Setup dialog while the document file is open, quit the program, and rerun the program, noting that 'WiSp' and 'PgFt' resources are created in the document file's resource fork if they do not already exist.

When done, the user may want to remove the preferences files from the Preferences folder.

## defines

rPrefsDialog represents the 'DLOG' resource ID for the Preferences dialog and the following three constants represent the item numbers of the dialog's checkboxes. rStringList and iPrefsFileName represent the 'STR#' resource ID and index for the string containing the name of the application's preferences file created by the first method. The next eight constants represent resource types and IDs for the custom preferences resource, the custom window state resource, the custom page format resource, and the application missing string resource.

## typedefs

The appPrefs data type is for the application preferences settings. The three Boolean fields are set by checkboxes in the Preferences dialog. The SInt16 field is incremented each time the program is run.

The windowSizePos data type is for the window size and position. The docStructure data type is for the window's document structure.

## Global Variables

gAppResFileRefNum will be assigned the file reference number for the application file's resource fork.

gSoundPref, gFullScreenPref, and gAutoScrollPref will hold the application preferences settings, as will gSoundCFPref, gFullScreenCFPref, and gAutoScrollCFPref.

gProgramRunCountPref will hold the number of times the application has been run, as will gProgramRunCountCFPref.

gPageFormatChanged is set to true when the Page Setup dialog is invoked, and determines whether a new page format resource will be written to the document file when the file is closed.

gPrefsFileRefNum will be assigned the file reference number for the preferences file's resource fork.

## main

The call to CurResFile sets the application's resource fork as the current resource file.

If the application is running on Mac OS X, `DeleteMenuItem` is called to delete the Preferences item and its preceding divider from the Edit menu. (On Mac OS X, the Preferences command is in the Application menu.) Since, on Mac OS X, the Preferences item is disabled by default, `EnableMenuCommand` is called to enable that item.

The call to `PMCreateSession` creates a printing session.

The calls to `doGetPreferencesResource` and `doGetPreferencesCFPrefs` read in the application preferences settings from the preferences files.

- If the preferences file to which the `doGetPreferencesResource` call pertains does not exist, a preferences file will be created, default preferences settings will be copied to it from the application file, and these default settings will then be read in from the newly-created file.
- If the preferences file to which the `doGetPreferencesCFPrefs` call pertains does not exist, a preferences file will be created by Core Foundation Preferences Services and default preferences settings will be copied to it.

### **appEventHandler**

When the `kEventProcessCommand` event type is received, if the `commandID` field of the `HICCommand` structure contains 'pref', the function `doPreferencesDialog` is called to display the Preferences dialog.

### **windowEventHandler**

When the `kWindowEventClose` event type is received, the function `doCloseWindow` is called. Amongst other things, `doCloseWindow` calls the function `doSaveWindowSizeAndPosition`, which saves the windows position and size to the resource fork of the document file.

### **doDrawContent**

`doDrawContent` simply prints the current preferences and page format information in the window for the information of the user.

### **doOpenCommand**

`doOpenCommand` is a much simplified version of the actions normally taken when a user chooses the Open command from a File menu. Note that, in this program, `NavGetFile`, rather than the Navigation Services 3.0 functions `NavCreateGetFileDialog` and `NavDialogRun`, is used to create and display the Open dialog.

`NavGetFile` presents the Open dialog. If the user clicks the Open button, `doOpenWindow` is called.

## doOpenWindow

doOpenWindow creates a new window, creates a block for a document structure, associates the document structure with the window object, assigns the file system specification for the chosen file to the document structure's file system specification field, sets the window's title, assigns NULL to the pageFormatHdl field of the document structure, and installs the window's event handler.

At that point, doLoadAndSetWindowSizeAndPosition is called to read in the window size and position ('Wisp') resource from the document's resource fork, and to position and size the window accordingly. In addition, doGetPageFormat is called to read in the page format ('PgFt') resource, and assign a handle to it to the pageFormatHdl field of the document structure.

With the window sized and positioned, ShowWindow is called to make the window visible (the window's 'WIND' resource specifies that the window is to be initially invisible) and a flag is set to indicate that the window is open.

## navEventFunction

A universal procedure pointer to a navigation event (callback) function must be passed in the eventProc parameter of the NavGetFile call if the Open dialog is to be movable and resizable. However, in a Carbon event model application this function may be empty if its only purpose would be to call the window's updating function, and if the window receives, and responds to, the kEventWindowDrawContent event type.

## doCloseWindow

doCloseWindow is called when the user chooses the Quit item, chooses Close from the File menu, or clicks the window's close box/button.

At the first two lines, a reference to the front window, and a handle to the associated document structure, are retrieved.

The call to doSaveWindowSizeAndPosition saves the window's port rectangle coordinates, converted to global coordinates, to the window size and position ('Wisp') resource in the document's resource fork. If the Page Setup dialog was invoked while the window was open, and if the user dismissed the dialog by clicking the OK button, a call is made to doSavePageFormat to save the PMPageFormat object to the page format ('PgFt') resource in the document file's resource fork.

DisposeHandle disposes of the document structure, DisposeWindow disposes of the window structure, and the last line sets the "window is open" flag to indicate that the window is not open.



### **doPreferencesDialog**

`doPreferencesDialog` is called when the user chooses the Preferences item. The function presents the Preferences dialog and sets the values in the global variables, which hold the current application preferences according to the settings of the dialog's checkboxes.

Note that, at the last two lines, calls are made to `doSavePreferencesResource` and `doSavePreferencesCFPrefs`.

### **doPageSetupDialog**

`doPageSetupDialog` is called when the user chooses the Page Setup item in the File menu. It presents the Page Setup dialog.

If the user dismisses the dialog with a click on the OK button, the flag, which indicates that a page format change has been made, is set to true.

### **doGetPreferencesResource**

`doGetPreferencesResource`, which is called from the main function immediately after program launch, is the first of those functions central to the demonstration aspects of the program. Its purpose is to create the preferences file if it does not already exist, copying the default preferences resource and the missing application string resource to that file as part of the creation process, and to read in the preferences resource from the previously existing or newly created preferences file.

`GetIndString` retrieves from the application's resource fork the resource containing the required name of the preferences file ("MoreResources Preferences").

`FindFolder` finds the location of the Preferences folder, returning the volume reference number and directory ID in the last two parameters. (Note that `kUserDomain` is passed in the `vRefNum` parameter. On Mac OS 8/9, this is mapped to `kOnSystemDisk`.) `FSMakeFSSpec` makes a file system specification from the preferences file name, volume reference number and directory ID. This file system specification is used in the `FSOpenResFile` call to open the resource fork of the preferences file with exclusive read/write permission.

If the specified file does not exist, `FSOpenResFile` returns -1. In that event `FSCreateResFile` creates the preferences file. The call to `FSCreateResFile` creates the file of the specified type on the specified volume in the specified directory and with the specified name and creator. (Note that the creator is set to an arbitrary signature, which no other application known to the Finder is likely to have. This is so that a double-click on the preferences file icon will cause the Finder to immediately display the missing application alert (Mac OS 8/9). Note also that, if 'pref' is used as the `fileType` parameter, the icon used for the file will be the system-supplied preferences document icon, which looks like this:

If the file is created successfully, the resource fork of the file is opened by `FSpOpenResFile` and the master preferences ('PrFn') and application missing 'STR' resources are copied to the resource fork from the application's resource file. If the resources are not successfully copied, `CloseResFile` closes the resource fork of the new file, `FspDelete` deletes the file, and the `fileRefNum` variable is set to indicate that the file does not exist.

If the preferences file exists (either previously or newly created), `UseResFile` sets the resource fork of that file as the current resource file, the preferences resource is read in from the resource fork by `Get1Resource` and, if the read was successful, the three Boolean values and one `SInt16` value that constitute the application's preference settings are assigned to the global variables which store those values. (Note that, in this program, the function `Get1Resource` is used to read in resources so as to restrict the Resource Manager's search for the specified resource to the current resource file.)

The penultimate line assigns the file reference number for the open preferences file resource fork to a global variable. (The fork is left open). The last line resets the application's resource fork as the current resource file.

### **doGetPreferencesCFPrefs**

`doGetPreferencesCFPrefs` is called from main to retrieve the application's preferences using Core Foundation Preferences Services routines.

Since the application ID in Java package name format (with ".plist" appended) exceeds the 31-character limit for Mac OS 8/9 filenames, an abbreviated ID is used if the program is running on Mac OS 8/9.

If the first call to `CFPreferencesGetAppBooleanValue` is successful, the preferences file exists and the Boolean value retrieved using the "sound" key is assigned to the relevant global variable. If this call is not successful, default values are assigned to the three global variables that hold the Boolean preferences values, and the function returns.

Two more calls to `CFPreferencesGetAppBooleanValue` with the appropriate keys retrieve the remaining two Boolean values and assign them to the relevant global variables. The call to `CFPreferencesGetAppIntegerValue` with the "run count" key retrieves the integer value representing the number of times the program has been run and assigns it to the relevant global variable.

### **doCopyResource**

`doCopyResource` is called by `doGetPreferences` to copy the default preferences and application missing string to the newly-created preferences file from the application file.

The first two lines save the current resource file's file reference number and set the application's resource fork as the current resource file. This will be the "source" file.

The `Get1Resource` call reads the specified resource into memory. `GetResInfo` gets the resource's name and `GetResAttrs` gets the resource's attributes. `DetachResource` replaces the resource's handle in the resource map with `NULL` without releasing the associated memory. The resource data is now simply arbitrary data in memory.

`UseResFile` sets the preferences file's resource fork as the current resource file. `AddResource` makes the arbitrary data in memory into a resource, assigning it the specified type, ID and name. `SetResAttrs` sets the resource attributes in the resource map. `ChangedResource` tags the resource for update and pre-allocates the required disk space. `WriteResource` then writes the resource to disk.

With the resource written to disk, `ReleaseResource` discards the resource in memory and `UseResFile` resets the resource file saved at the first line as the current resource file.

### **doSavePreferencesResource**

`doSavePreferencesResource` is called when the user dismisses the Preferences dialog to save the new preference settings to the preferences file created by `doGetPreferencesResource`. It assumes that that preferences file is already open.

At the first two lines, if `doGetPreferences` was not successful in opening the preferences file at program launch, the function simply returns. The call to `CurResFile` saves the file reference number of the current resource file for later restoration.

The next six lines create a new preferences structure and assign to its fields the values in the global variables which store the current preference settings. `UseResFile` makes the preferences file's resource fork the current resource file. `Get1Resource` gets a handle to the existing preferences resource. Assuming the call is successful (that is, the preferences resource exists), `RemoveResource` is called to remove the resource from the resource map, `AddResource` is called to make the preferences structure in memory into a resource, and `WriteResource` is called to write the resource data to disk.

`ReleaseResource` disposes of the preferences structure in memory and `UseResFile` makes the previously saved resource file the current resource file.

### **doSavePreferencesCFPrefs**

`doSavePreferencesCFPrefs` is called when the user dismisses the Preferences dialog to set and store the new preference settings using Core Foundation Preferences Services functions.

Since the application ID in Java package name format (with “.plist” appended) exceeds the 31-character limit for Mac OS 8/9 filenames, an abbreviated ID is used if the program is running on Mac OS 8/9.

For the three Boolean preferences values, `CFPreferencesSetAppValue` is called with the appropriate key to set the values in the application’s preferences cache. For the program run count (integer) value, `NumToString` and `CFStringCreateWithPascalString` are called to convert the integer value to a `CFString` before `CFPreferencesSetAppValue` is called.

The call to `CFPreferencesAppSynchronize` flushes the cache to permanent storage, creating the preferences file if it does not already exist.

### **doLoadAndSetWindowSizeAndPosition**

`doLoadAndSetWindowSizeAndPosition` gets the window size and position (‘WiSp’) resource from the resource fork of the document file and moves and sizes the window according to retrieved size and position data.

`GetWRefCon` gets a handle to the window’s document structure so that the file system specification can be retrieved and used in the `FSpOpenResFile` call to open the document file’s resource fork.

`Get1Resource` attempts to read in the ‘WiSp’ resource. If the `Get1Resource` call is successful, the retrieved data is assigned to a local variable of type `Rect`. (Recall that this is the window’s port rectangle in global coordinates.) If `Get1Resource` call is not successful (as it will be if no ‘WiSp’ resource currently exists in the document file’s resource fork), a default size and position for the window is established.

The calls to `MoveWindow` and `SizeWindow` set the position and size of the window to either the retrieved or default position and size.

### **doSaveWindowSizeAndPosition**

`doSaveWindowSizeAndPosition` saves the current window size and position (the window’s port rectangle in global coordinates) to the document file’s resource fork, and is called when the associated window is closed by the user or the Quit item is chosen.

The first line gets a handle to the window’s document structure so that the document file’s file system specification can be retrieved and used in the `FSpOpenResFile` call. If the resource fork cannot be opened, an error alert is presented and the function simply returns.

The next block gets the window’s port rectangle, converts it to global coordinates, and assigns it to the `windowRect` field of a `windowSizePosStruct` structure.

Get1Resource attempts to read the 'WiSp' resource from the document's resource fork into memory. If the Get1Resource call is successful, the resource in memory is made equal to the previously "filled-in" windowSizePosStruct structure and the resource is tagged as changed. If the Get1Resource call is not successful (that is, the document file's resource fork does not yet contain a 'WiSp' resource), the else block creates a new windowSizePosStruct structure, makes this structure equal to the previously "filled-in" windowSizePosStruct structure, and makes this data in memory into a 'WiSp' resource.

If an existing 'WiSp' resource was successfully read in, or if a new 'WiSp' resource was successfully created in memory, UpdateResFile writes the resource data and map to disk, and ReleaseResource discards the resource in memory. The document file's resource fork is then closed by CloseResFile.

### **doGetPageFormat**

doGetPageFormat reads in the 'PgFt' resource, which contains a flattened PMPageFormat object, from the document file's resource fork. The function is called when the document is opened.

The first line gets a handle to the window's document structure so that the document file's file system specification can be retrieved and used in the call to FSpOpenResFile. If the call is not successful, an error alert is presented and the function simply returns.

If the resource fork is successfully opened, the call to Get1Resource attempts to read in the resource. If the call is successful, the resource is unflattened into a PMPageFormat object, PMValidatePageFormat is called to ensure that the page format information is compatible with the driver for the current printer, and PMFlattenPageFormat is called to flatten the PMPageFormat object. When PMFlattenPageFormat returns, the second parameter (the relevant field of the window's document structure) contains a handle to the flattened data. The resource is then released and the document file's resource fork is closed.

### **doSavePageFormat**

doSavePageFormat saves the flattened PMPageFormat object, whose handle is stored in the window's document structure, to a 'PgFt' resource in the document file's resource fork. The function is called when the file is closed if the user invoked the PageSetup dialog while the document was open and dismissed the dialog by clicking the OK button.

The first line gets a handle to the window's document structure so that the document file's file system specification can be retrieved and used in the call to FSpOpenResFile. If the call is not successful, an error alert is presented and the function simply returns.

`Get1Resource` attempts to read the 'PgFt' resource from the document's resource fork into memory. If the `Get1Resource` call is successful, the contents of the handle in the document structure's `pageFormatHdl` field are copied to the resource in memory, and the resource is tagged as changed. If the `Get1Resource` call is not successful (that is, the document file's resource fork does not yet contain a 'PgFt' resource), a block of memory the size of a 'PgFt' resource is allocated, the contents of the handle in the document structure's `pageFormatHdl` field are copied to that block, and `AddResource` makes that block into a 'PgFt' resource.

If an existing 'PgFt' resource was successfully read in, or if a new 'PgFt' resource was successfully created in memory, `UpdateResFile` writes the resource map and data to disk. `ReleaseResource` then discards the resource in memory. At the last line, the document file's resource fork is then closed.





## IN THIS CHAPTER

- The Carbon Scrap Manager and the Scrap 1094
- Private Scrap 1100
- TextEdit, Dialogs, and Scrap 1103
- Main Carbon Scrap Manager Constants, Data Types, and Functions 1104
- Demonstration Program CarbonScrap Listing 1105
- Demonstration Program CarbonScrap Comments 1125



# The Carbon Scrap Manager and the Scrap

## Introduction

The inclusion of the word “Carbon” in the title of this chapter is quite deliberate, reflecting the fact that, in Carbon, the original Scrap Manager has been redesigned to fully support the needs of the preemptively scheduled Mac OS X.

Applications which support cut, copy, and paste operations write data to, and read data from, the scrap. The scrap is a storage area, maintained by the **Scrap Manager**, which holds the last text, graphics, sounds, etc., cut or copied by the user.

The various data formats in which data may be written to, and read from, the scrap are called **scrap flavors**. A scrap flavor is a self-contained, self-describing stream of bytes that represent a discreet object such as a picture or text selection. Each scrap flavor has a **scrap flavor type** and a set of **scrap flavor flags**. The scrap may contain data in one or more flavors, each flavor being a different representation of the same object.

Your application specifies the scrap flavor, or flavors, to be read from, and written to, the scrap. The ultimate aim is to allow the user to copy and paste documents

- Within a document created by your application.
- Between different documents created by your application.
- Between documents created by your application and documents created by other applications.

## Location of the Scrap

On Mac OS 8/9, space is allocated for the scrap in each application’s heap. The system software stores a handle to the scrap of the current process in the system global variable `ScrapHandle`. When an application is launched, data is copied to the newly activated application’s heap from the previously active application’s heap. If the scrap is too large to fit in the application’s heap, the scrap is copied to disk. In this event, the handle to the scrap is set to `NULL` to indicate that the scrap is on disk.

On Mac OS X, the scrap is held by the pasteboard server.

## Scrap Reference

A scrap is referred to by a scrap reference. The data type `ScrapRef` is defined as a pointer to a scrap reference:

```
typedef struct OpaqueScrapRef *ScrapRef;
```

Note that, although there is only one scrap, there may be multiple `ScrapRef` values. A `ScrapRef` value is valid only until the scrap is cleared.

## Scrap Flavors

### Standard Scrap Flavors

Your application should be capable of writing at least one of the following **standard scrap flavors** to the scrap and should be capable of reading both:

- `'TEXT'` (a series of ASCII characters in the same format as a `'TEXT'` resource).
- `'PICT'` (a QuickDraw picture in the same format as a `'PICT'` resource).

### Optional Flavors

Your application may also choose to support the following optional scrap flavors:

- `'styl'` (a series of bytes that describe styled text data, and which have the same format as a TextEdit `'styl'` resource).
- `'movv'` (a series of bytes that define a movie, and which have the same format as a `'movv'` resource).

### Private Flavors

It is also possible for your application to use its own private flavor, or flavors, but this should be in addition to at least one of the standard flavors.

### Preferred Flavor

Recall that each flavor in the scrap (assuming there is more than one) is simply a different representation of the same object.

Your application should have a **preferred scrap flavor**. When reading data from the scrap, your application should request its preferred flavor first and only request its next preferred flavor if the preferred flavor does not exist in the scrap. When writing data to the scrap, your application should write its preferred flavor first. Any additional flavors should be written in the preferred order.

## Implementing Edit Menu Commands

You use the Edit menu Cut, Copy, and Paste commands to implement cutting, copying, and pasting of data within or between documents. The following are the actions your application should perform to support these three commands:

<i>Edit Command</i>	<i>Actions Performed by Your Application</i>
Cut	If there is a current selection range, write the data in the selection range to the scrap and remove the data from the document.
Copy	If there is a current selection range, write the data in the selection range to the scrap.
Paste	Read the scrap and insert the data (if any) at the insertion point, replacing any current selection.

**NOTE**

The insertion point in a text document is represented by the blinking vertical bar known as the **caret**. There is a close relationship between the selection range and the insertion point in that the insertion point is, in effect, an empty selection range.

If your application implements a Clear command, it should remove the data in the current selection range but should not save the data to the scrap.

## Cut and Copy—Putting Data in the Scrap

A typical approach to a basic implementation of the Cut and Copy commands is as follows:

- Determine whether the frontmost window is a document window or a dialog.
- If the frontmost window is a document window
  - Call `ClearCurrentScrap` to purge the current contents of the scrap.
  - Call `GetCurrentScrap` to obtain a reference to the current scrap.
  - Determine whether the current selection contains text or a picture.
  - If the current selection is text, get a pointer to the selected text and get the size of the selection. If the current selection is a picture, get a pointer to the picture structure and get the size of that structure.
  - Call `PutScrapFlavor` to write the data to the scrap, passing the appropriate flavor type in the `flavorType` parameter.
  - If the command was the Cut command, delete the selection from the current document.
- If the frontmost window is a dialog, use the Dialog Manager functions `DialogCut` or `DialogCopy`, as appropriate, to write the selected data to the scrap.

## Paste—Getting Data From the Scrap

When you read the data from the scrap, your application should request the data in the application's preferred flavor type. If your application determines that that flavor does not exist in the

scrap, it should then request the data in another flavor. If your application does not have a preferred flavor type, it should read each flavor type that your application supports.

If you request a scrap format that is not in the scrap, the Scrap Manager uses the Translation Manager to convert any one of the scrap flavor types currently in the scrap into the scrap flavor requested by your application. The Translation Manager looks for a translator that can perform one of these translations. If such a translator is available, the Translation Manager uses the translator to translate the data in the scrap into the requested flavor.

A typical approach to an implementation of the Paste command, for an application that prefers a flavor type of 'TEXT' as its first preference, is as follows:

- Determine whether the frontmost window is a document window or a dialog.
- If the frontmost window is a document window
  - Call `GetCurrentScrap` to obtain a reference to the current scrap.
  - Call `GetScrapFlavorFlags` to determine whether the preferred flavor exists in the scrap.
  - If the preferred flavor type ('TEXT') does exist, call `GetScrapFlavorSize` to get the size of the text data, allocate a relocatable block of that size, and call `GetScrapFlavorData` to read the data into that block. Copy the data in the relocatable block to the current document at the insertion point.
  - If the preferred flavor type does not exist, call `GetScrapFlavorFlags` again to determine whether the next preferred flavor (say, 'PICT') exists in the scrap. If it does, call `GetScrapFlavorSize` to get the size of the picture data, allocate a relocatable block of that size, and call `GetScrapFlavorData` to read the data into that block. Call `DrawPicture` to draw the picture described by the data in the relocatable block in the current document at the insertion point.
- If the frontmost window is a , use the Dialog Manager function `DialogPaste` to paste the text from the scrap in the dialog.

### Enabling the Paste Menu Item

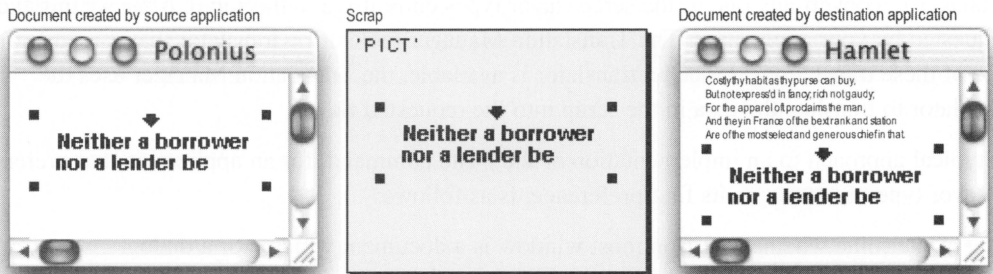
Your application can determine whether to enable the Paste item in the Edit menu by calling `GetScrapFlavorFlags` to determine whether the scrap contains data of the flavor type specified in that call. `GetScrapFlavorFlags` returns `noErr` if the specified flavor exists.

### Example

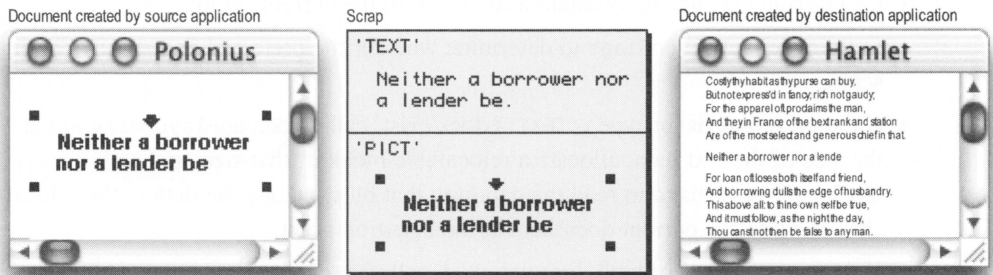
Fig 1 illustrates two cases, both of which deal with a user copying a picture consisting of text from a source document created by one application to a destination document created by another application.

In the first case, the source application has chosen to write only the 'PICT' flavor to the scrap, and the destination application has pasted the data, in that flavor, to its document.

In the second case, the source application has chosen to write both the 'TEXT' and 'PICT' flavors to the scrap, and the destination application has chosen the 'TEXT' flavor as the preferred flavor for the paste. The data is thus inserted into the document as editable text.



CASE 1 - SOURCE APPLICATION WRITES 'PICT' FLAVOUR ONLY



CASE 2 : SOURCE APPLICATION WRITES 'TEXT' AND 'PICT' FLAVOURS, DESTINATION APPLICATION SPECIFIES 'TEXT' AS PREFERRED FLAVOUR FOR READ

FIG 1 - SPECIFYING FLAVOURS TO WRITE TO AND READ FROM THE DESK SCRAP

## Clipboard Windows

Your application can provide a Show Clipboard command in the Edit menu which, when chosen, shows a window that displays the current contents of the scrap. Such a window is known as a **Clipboard** window. The Show Clipboard command should be toggled with a Hide Clipboard command to allow the user to hide the Clipboard window when required.

Although the scrap may contain multiple scrap flavors, your Clipboard window should ordinarily display the data in the application's preferred flavor only.

If the user has chosen to open the Clipboard window, your application should hide the window on receipt of a suspend event (Classic event model) or `kEventAppActivated` event type (Carbon event model) and show it when a resume event (Classic event model) or `kEventAppDeactivated` event type (Carbon event model) is received. This is necessary because the contents of the scrap could change while the application is in the background.

## Transferring the Scrap to Disk —Mac OS 8/9

Although, on Mac OS 8/9, the scrap is usually located in memory, your application can write the contents of the scrap in memory to a scrap file using `UnloadScrap`. You should do this only if memory is not large enough to hold the data you need to write to the scrap. After writing the contents of the scrap to disk, `UnloadScrap` releases the memory previously occupied by the scrap. Thereafter, any operations your application performs on data in the scrap affect the scrap as stored in the scrap file on disk. You can use `LoadScrap` to read the contents of the scrap file back into memory.

On Mac OS X, calls to `LoadScrap` and `UnloadScrap` are ignored.

## Main Carbon Scrap Manager Functions

The main Carbon Scrap Manager functions are as follows:

<i>Function</i>	<i>Description</i>
<code>GetCurrentScrap</code>	Gets a reference to the current scrap. (Note that this reference will become invalid and unusable after the scrap is cleared.)
<code>GetScrapFlavorFlags</code>	Determines whether the scrap contains data for a particular flavor and provides information about that flavor if it exists. (This function is useful for deciding whether to enable the Paste item in your Edit menu.)
<code>GetScrapFlavorSize</code>	Gets the size of the data of the specified flavor from the specified scrap.
<code>GetScrapFlavorData</code>	Gets the data of the specified flavor from the specified scrap.
<code>ClearCurrentScrap</code>	Clears the current scrap. This function should be called immediately the user requests a Copy or Cut operation.
<code>PutScrapFlavor</code>	Puts data on the scrap. Also promises data to the specified scrap (see below).

## Associated Constants and Data Types

The following constants and data types are associated with the main Scrap Manager functions:

### Scrap Flavor Type Constants

<i>Constant</i>	<i>Flavor Type</i>	<i>Description</i>
<code>kScrapFlavorTypePicture</code>	'PICT'	Picture
<code>kScrapFlavorTypeText</code>	'TEXT'	Text
<code>kScrapFlavorTypeTextStyle</code>	'styl'	Text style
<code>kScrapFlavorTypeMovie</code>	'moov'	Movie

### Scrap Flavor Flag Constants

In the following, the first two constants may be passed in the `flavorFlags` parameter in calls to `PutScrapFlavor`, and the third is received in the `flavorFlags` parameter in calls to `GetScrapFlavorFlags`:

<i>Constant</i>	<i>Meaning</i>
<code>kScrapFlavorMaskNone</code>	No flags required.
<code>kScrapFlavorMaskSenderOnly</code>	Only the process, which puts the flavor on the scrap, can see it.  If another process puts a flavor with this flag on the scrap, your process will never see the flavor. Accordingly, there is no point in testing for this flag.  This flag is typically used to save a private flavor to the scrap so that other promised (see below) public flavors can be derived from it on demand.
<code>kScrapFlavorMaskTranslated</code>	The flavor was translated, by the Translation Manager, from some other flavor in the scrap. (Most callers should not care about this flag.)

### ScrapFlavorInfo Data Type

The `ScrapFlavorInfo` data type describes a single flavor within a scrap and is used by those functions that get information about the current scrap (`GetScrapFlavorFlags`, `GetScrapFlavorSize`, and `GetScrapFlavorData`):

```
struct ScrapFlavorInfo
{
    ScrapFlavorType  flavorType;
    ScrapFlavorFlags flavorFlags;
};
typedef struct ScrapFlavorInfo ScrapFlavorInfo;
```

## Private Scrap

As an alternative to writing to and reading from the scrap whenever the user cuts, copies, and pastes data, your application can choose to use its own **private scrap**. An application that uses a private scrap copies data to its private scrap when the user chooses the Cut or Copy command and pastes data from the private scrap when the user chooses the Paste command.

## Additional Actions—Old Scrap Manager

In the old pre-Carbon Scrap Manager, an application that used a private scrap had to take the following additional actions whenever it received suspend and resume events:



- **Suspend Event.** On receipt of a suspend event, the application had to copy data from the private scrap to the scrap.
- **Resume Event.** On receipt of a resume event, the application had to first examine the `convertClipboardFlag` bit in the message field of the resume event structure to determine if the data in the scrap had changed since the previous suspend event. If the data in the scrap had changed, the application had to copy the data from the scrap to its private scrap. The application's menu adjustment function enabled the Paste item if the data copied to the private scrap was of the preferred, or other acceptable, type.

The process is illustrated in Fig 2.

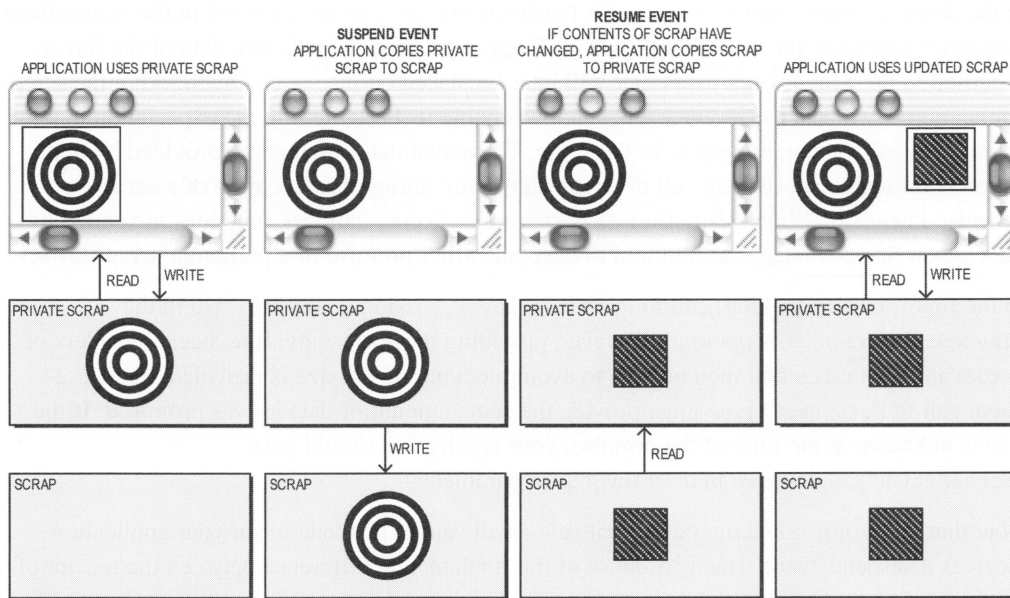


FIG 2 - PRIVATE SCRAP AND SUSPEND AND RESUME EVENTS - OLD SCRAP MANAGER

## Additional Actions—Carbon Scrap Manager

In the preemptively scheduled Mac OS X, this rather straightforward approach is no longer feasible. Consider the following scenario on Mac OS X:

- Application B, which has a private scrap, is the frontmost application. The user clicks in a window belonging to application A to make application A the frontmost application. Application B receives a suspend event and begins to convert its private scrap.
- While application B is still converting its private scrap, application A has become the frontmost application, and the user clicks in its menu bar. Application A, needing to



decide whether to enable the Paste item in its Edit menu, looks at the scrap to determine what flavors it contains. Because application B has not finished converting its private scrap, and thus has not put anything onto the scrap, application A finds nothing it wants on the scrap and, accordingly, disables the Paste item.

The situation in which application A finds itself with regard to the Paste item is not acceptable in terms of human interface. The user cannot be expected to know that application B is still converting its scrap and that application A's Paste item will be enabled in due course.

## Making Promises

The Carbon Scrap Manager eliminates this problem using the concept of **promised flavors**. If, in the above example, application B calls `PutScrapFlavor` with `NULL` passed in the `flavorData` parameter whenever the user chooses Cut or Copy, a promise is made that data of the flavor specified in the `flavorType` parameter will later be placed on the scrap. On checking the scrap, application A will see the promise and can thus enable its Paste item in the expectation that the actual data will eventually appear in the scrap. The actual data can then be provided by application B through a subsequent call to `PutScrapFlavor` during the execution of a **scrap promise keeper (callback) function**. (Scrap promise keeper callback functions are called by the Carbon Scrap Manager as required to keep an earlier promise of a particular scrap flavor.)

In the first (promise-making) call to `PutScrapFlavor`, passing a non-zero size in the `flavorSize` parameter is optional; however, providing the size is advisable because callers of `GetScrapFlavorSize` will then be able to avoid blocking. If the size is provided, the subsequent call to `PutScrapFlavor` must provide the same amount of data as was promised. If the size is unknown at the time of the promise, your application should pass `kScrapFlavorSizeUnknown` in the `flavorSize` parameter.

Note that the promise-making `PutScrapFlavor` call cannot be made when your application receives a suspend event. This is because of the fundamental difference between the receipt of suspend events in Carbon applications as compared with Classic applications (see Chapter 2). Making the promise each time the user chooses Cut or Copy involves very little overhead, since only the promise, not the data, is being placed on the scrap.

## Calling In Promises

In applications that use the Classic event model, your application should invariably call `CallInScrapPromises` on exit to cater for the possibility that it may have made promises that, after it quits, it cannot possibly honor. `CallInScrapPromises` forces all promises to be kept. On Mac OS X, this action is necessary even if your application has itself made no promises, the reason being that it is possible that, unbeknown to the application, promises could have been made on its behalf. For example, when you copy TEXT data (which has ASCII 13 for line endings) onto the scrap, the Carbon Scrap Manager promises other flavors, which have different line endings and/or text encodings so that Cocoa applications can paste.

Calling `CallInScrapPromises` is not necessary in applications which use the Carbon event model.

## TextEdit, Dialogs, and Scrap

### TextEdit and Scrap

TextEdit is a collection of functions and data structures that you can use to provide your application with basic text editing capabilities.

If your application uses TextEdit in its windows, be aware that TextEdit maintains its own private scrap. Accordingly

- The special TextEdit functions `TECut`, `TECopy`, and `TEToScrap` are used in the processes of cutting text from the document and copying text to the TextEdit private scrap and to the scrap.
- The special TextEdit functions `TEPaste`, `TEStylePaste`, and `TEFromScrap` are used in the processes of pasting text from the TextEdit private scrap and copying text from the scrap to the TextEdit private scrap.

Chapter 21 describes TextEdit, including the TextEdit private scrap and the TextEdit scrap-related functions.

### Dialogs and Scrap

Dialogs may contain edit text items, and the Dialog Manager uses TextEdit to perform the editing operations within those items.

You can use the Dialog Manager to handle most editing operations within dialogs. The Dialog Manager functions `DialogCut`, `DialogCopy`, and `DialogPaste` may be used to implement Cut, Copy and Paste commands within edit text items in dialogs. (See the demonstration program in Chapter 8.)

TextEdit's private scrap facilitates the copying and pasting of data between dialogs. However, your application itself must ensure that the user can copy and paste data between your application's dialogs and its document windows. If your application uses TextEdit for all editing operations within its document windows, this is easily achieved because TextEdit's `TECut`, `TECopy`, `TEPaste`, and `TEStylePaste` functions and the Dialog Manager's `DialogCut`, `DialogCopy`, and `DialogPaste` functions all use TextEdit's private scrap.

# Main Carbon Scrap Manager Constants, Data Types, and Functions

## Constants

### Scrap Flavor Types

```
kScrapFlavorTypePicture = FOUR_CHAR_CODE('PICT') Picture
kScrapFlavorTypeText    = FOUR_CHAR_CODE('TEXT') Text
kScrapFlavorTypeTextStyle = FOUR_CHAR_CODE('styl') Text style
kScrapFlavorTypeMovie   = FOUR_CHAR_CODE('moov') Movie
```

### Scrap Flavor Flags

```
kScrapFlavorMaskNone      = 0x00000000
kScrapFlavorMaskSenderOnly = 0x00000001
kScrapFlavorMaskTranslated = 0x00000002
```

### Promising Flavors

```
kScrapFlavorSizeUnknown = -1
```

### Result Codes

```
internalScrapErr          = -4988
duplicateScrapFlavorErr   = -4989
badScrapRefErr            = -4990
processStateIncorrectErr  = -4991
scrapPromiseNotKeptErr    = -4992
noScrapPromiseKeeperErr   = -4993
nilScrapFlavorDataErr     = -4994
scrapFlavorFlagsMismatchErr = -4995
scrapFlavorSizeMismatchErr = -4996
illegalScrapFlavorFlagsErr = -4997
illegalScrapFlavorTypeErr = -4998
illegalScrapFlavorSizeErr = -4999
scrapFlavorNotFoundErr    = -102
needClearScrapErr         = -100
```

## Data Types

```
typedef struct OpaqueScrapRef *ScrapRef;
typedef FourCharCode          ScrapFlavorType;
typedef UInt32                ScrapFlavorFlags;
```

### ScrapFlavorInfo

```
struct ScrapFlavorInfo
{
    ScrapFlavorType flavorType;
    ScrapFlavorFlags flavorFlags;
};
typedef struct ScrapFlavorInfo ScrapFlavorInfo;
```

## Functions

### Obtaining a Reference to the Current Scrap

```
OSStatus GetCurrentScrap(ScrapRef *scrap);
```

### Obtaining Information About a Specific Scrap Flavor

```
OSStatus GetScrapFlavorFlags(ScrapRef scrap, ScrapFlavorType flavorType,
                             ScrapFlavorFlags *flavorFlags);
```

### Obtaining the Size of Data of a Specified Scrap Flavor

```
OSStatus GetScrapFlavorSize(ScrapRef scrap, ScrapFlavorType flavorType, Size *byteCount);
```

### Obtaining the Data of a Specified Scrap Flavor

```
OSStatus GetScrapFlavorData(ScrapRef scrap, ScrapFlavorType flavorType, Size *byteCount,
                             void *destination);
```

### Writing Data to the Scrap and Clearing the Scrap

```
OSStatus PutScrapFlavor(ScrapRef scrap, ScrapFlavorType flavorType,
                        ScrapFlavorFlags flavorFlags, Size flavorSize, const void *flavorData);
OSStatus ClearCurrentScrap(void);
```

### Scrap Promise Keeping

```
ScrapPromiseKeeperUPP NewScrapPromiseKeeperUPP(ScrapPromiseKeeperProcPtr userRoutine);
void DisposeScrapPromiseKeeperUPP(ScrapPromiseKeeperUPP userUPP);
OSStatus SetScrapPromiseKeeper(ScrapRef scrap, ScrapPromiseKeeperUPP upp,
                               const void *userData);
OSStatus CallInScrapPromises(void);
```

### Application-Defined (Callback) Function

```
OSStatus myScrapPromiseKeeperFunction(ScrapRef scrap, ScrapFlavorType flavorType,
                                       void *userData);
```

### Transferring the Scrap Between Memory and Disk (Mac OS 8/9)

```
SInt32 UnloadScrap(void); // Does nothing when called on Mac OS X
SInt32 LoadScrap(void);  // Does nothing when called on Mac OS X
```

## Demonstration Program CarbonScrap Listing

```
// *****
// CarbonScrap.c CARBON EVENT MODEL
// *****
//
// This program utilises Carbon Scrap Manager functions to allow the user to:
//
// • Cut, copy, clear, and paste text and pictures from and to two document windows opened by
//   the program.
//
// • Paste text and pictures cut or copied from another application to the two document
//   windows.
//
```

```

// · Open and close a Clipboard window, in which the current contents of the scrap are
//   displayed.
//
// The program's preferred scrap flavor type is 'TEXT'. Thus, if the scrap contains data in
// both the 'TEXT' and 'PICT' flavor types, only the 'TEXT' flavor will be used for pastes
// to the document windows and display in the Clipboard window.
//
// In order to keep that part of the source code that is not related to the Carbon Scrap
// Manager to a minimum, the windows do not display insertion points, nor can the pictures be
// dragged within the windows. The text and pictures are not inserted into a document as
// such. Rather, when the Paste item in the Edit menu is chosen:
//
// · The text or picture on the Clipboard is simply drawn in the center of the active window.
//
// · A handle to the text or picture is assigned to fields in a document structure associated
//   with the window. (The demonstration program MonoTextEdit (Chapter 21) shows how to cut,
//   copy, and paste text from and to a TextEdit structure using the scrap.)
//
// For the same reason, highlighting the selected text or picture in a window is simplified by
// simply inverting the image.
//
// The program utilises the following resources:
//
// · A 'plst' resource.
//
// · An 'MBAR' resource, and 'MENU' resources for Apple, File, and Edit menus (preload,
//   non-purgeable).
//
// · A 'TEXT' resource (non-purgeable) containing text displayed in the left window at
//   program start.
//
// · A 'PICT' resource (non-purgeable) containing a picture displayed in the right window at
//   program start.
//
// · A 'STR#' resource (purgeable) containing strings to be displayed in the error Alert.
//
// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenubar          128
#define mAppleApplication 128
#define iAbout            1
#define mFile             129
#define iClose            4
#define iQuit             12
#define mEdit             130

```

```

#define iCut          3
#define iCopy         4
#define iPaste        5
#define iClear        6
#define iClipboard    8
#define rText         128
#define rPicture      128
#define rErrorStrings 128
#define eFailMenu     1
#define eFailWindow   2
#define eFailDocStruc 3
#define eFailMemory   4
#define eClearScrap   5
#define ePutScrapFlavor 6
#define eGetScrapSize 7
#define eGetScrapData 8
#define kDocumentType 1
#define kClipboardType 2
#define MAX_UINT32     0xFFFFFFFF

```

```
// ..... typedefs
```

```
typedef struct
```

```

{
    PicHandle pictureHdl;
    Handle     textHdl;
    Boolean    selectFlag;
    SInt16     windowType;
} docStructure, **docStructureHandle;

```

```
// ..... global variables
```

```

Boolean    gRunningOnX      = false;
WindowRef  gClipboardWindowRef = NULL;
Boolean    gClipboardShowing = false;

```

```
// ..... function prototypes
```

```

void        main                (void);
void        doPreliminaries     (void);
OSStatus    appEventHandler     (EventHandlerCallRef, EventRef, void *);
OSStatus    docWindowEventHandler (EventHandlerCallRef, EventRef, void *);
OSStatus    clipWindowEventHandler (EventHandlerCallRef, EventRef, void *);
void        doAdjustMenus       (void);
void        doMenuChoice        (MenuID, MenuItemIndex);
void        doErrorAlert        (SInt16);
void        doOpenDocumentWindows (void);
EventHandlerUPP doGetHandlerUPP  (void);
void        doCloseWindow       (void);
void        doInContent          (Point);
void        doCutCopyCommand     (Boolean);
void        doPasteCommand       (void);
void        doClearCommand       (void);
void        doClipboardCommand   (void);

```

```

void          doDrawClipboardWindow (void);
void          doDrawDocumentWindow (WindowRef);
Rect          doSetDestRect          (Rect *, WindowRef);

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    Sint32        response;
    MenuRef        menuRef;
    EventTypeSpec applicationEvents[] = { { kEventClassApplication, kEventAppActivated },
                                           { kEventClassApplication, kEventAppDeactivated },
                                           { kEventClassCommand,      kEventProcessCommand },
                                           { kEventClassMenu,          kEventMenuEnableItems } };

    // ..... do preliminaries

    doPreliminaries();

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMenubar);
    if(menubarHdl == NULL)
        doErrorAlert(eFailMenu);
    SetMenuBar(menubarHdl);
    DrawMenuBar();

    Gestalt(gestaltMenuMgrAttr, &response);
    if(response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
        {
            DeleteMenuItem(menuRef, iQuit);
            DeleteMenuItem(menuRef, iQuit - 1);
            DisableMenuItem(menuRef, 0);
        }

        gRunningOnX = true;
    }
    else
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
            SetMenuItemCommandID(menuRef, iQuit, kHICCommandQuit);
    }

    // ..... open document windows

    doOpenDocumentWindows();

```

```

// ..... install application event handler

InstallApplicationEventHandler(NewEventHandlerUPP((EventHandlerProcPtr) appEventHandler),
                             GetEventTypeCount(applicationEvents), applicationEvents,
                             0, NULL);

// ..... run application event loop

RunApplicationEventLoop();
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(96);
    InitCursor();
}

// ***** appEventHandler

OSStatus appEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                        void * userData)
{
    OSStatus result = eventNotHandledErr;
    UInt32 eventClass;
    UInt32 eventKind;
    HICCommand hiCommand;
    MenuID menuID;
    MenuItemIndex menuItem;

    eventClass = GetEventClass(eventRef);
    eventKind = GetEventKind(eventRef);

    switch(eventClass)
    {
        case kEventClassApplication:
            if(eventKind == kEventAppActivated)
            {
                SetThemeCursor(kThemeArrowCursor);
                if(gClipboardWindowRef && gClipboardShowing)
                    ShowWindow(gClipboardWindowRef);
            }
            else if(eventKind == kEventAppDeactivated)
            {
                if(gClipboardWindowRef && gClipboardShowing)
                    ShowHide(gClipboardWindowRef, false);
            }
            break;

        case kEventClassCommand:
            if(eventKind == kEventProcessCommand)

```



```

    {
        GetEventParameter(eventRef, kEventParamDirectObject, typeHICCommand, NULL,
                           sizeof(HICCommand), NULL, &hiCommand);
        menuID = GetMenuID(hiCommand.menu.menuRef);
        menuItem = hiCommand.menu.menuItemIndex;
        if((hiCommand.commandID != kHICCommandQuit) &&
            (menuID >= mAppleApplication && menuID <= mEdit))
        {
            doMenuChoice(menuID, menuItem);
            result = noErr;
        }
    }
    break;

case kEventClassMenu:
    if(eventKind == kEventMenuEnableItems)
        doAdjustMenus();
    result = noErr;
    break;
}

return result;
}

// ***** docWindowEventHandler

OSStatus docWindowEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                               void * userData)
{
    OSStatus          result = eventNotHandledErr;
    UInt32            eventClass;
    UInt32            eventKind;
    WindowRef          windowRef;
    docStructureHandle docStrucHdl;
    Point              mouseLocation;

    eventClass = GetEventClass(eventRef);
    eventKind = GetEventKind(eventRef);

    switch(eventClass)
    {
    case kEventClassWindow:
        GetEventParameter(eventRef, kEventParamDirectObject, typeWindowRef, NULL, sizeof(windowRef),
                           NULL, &windowRef);
        switch(eventKind)
        {
        case kEventWindowDrawContent:
            docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
            if((*docStrucHdl->pictureHdl != NULL || (*docStrucHdl->textHdl != NULL))
                doDrawDocumentWindow(windowRef);
            result = noErr;
            break;
        }
    }
}

```

```

        case kEventWindowClickContentRgn:
            GetEventParameter(eventRef, kEventParamMouseLocation, typeQDPoint, NULL,
                               sizeof(mouseLocation), NULL, &mouseLocation);
            SetPortWindowPort(windowRef);
            GlobalToLocal(&mouseLocation);
            doInContent(mouseLocation);
            result = noErr;
            break;
    }
    break;
}

return result;
}

// ***** clipWindowEventHandler

OSStatus clipWindowEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                                void * userData)
{
    OSStatus result = eventNotHandledErr;
    UInt32 eventClass;
    UInt32 eventKind;
    MenuRef editMenuRef;

    eventClass = GetEventClass(eventRef);
    eventKind = GetEventKind(eventRef);

    if(eventClass == kEventClassWindow)
    {
        switch(eventKind)
        {
            case kEventWindowActivated:
            case kEventWindowDeactivated:
            case kEventWindowDrawContent:
                doDrawClipboardWindow();
                result = noErr;
                break;

            case kEventWindowClose:
                DisposeWindow(gClipboardWindowRef);
                gClipboardWindowRef = NULL;
                gClipboardShowing = false;
                editMenuRef = GetMenuRef(mEdit);
                SetMenuItemText(editMenuRef, iClipboard, "\pShow Clipboard");
                break;
        }
    }

    return result;
}

```

```
// ***** doAdjustMenus

void doAdjustMenus(void)
{
    MenuRef          fileMenuRef, editMenuRef;
    docStructureHandle docStrucHdl;
    ScrapRef          scrapRef;
    OSStatus          osError;
    ScrapFlavorFlags   scrapFlavorFlags;
    Boolean            scrapHasText = false, scrapHasPicture = false;

    fileMenuRef = GetMenuRef(mFile);
    editMenuRef = GetMenuRef(mEdit);

    docStrucHdl = (docStructureHandle) GetWRefCon(FrontWindow());

    if ((*docStrucHdl)->windowType == kClipboardType)
        EnableMenuItem(fileMenuRef, iClose);
    else
        DisableMenuItem(fileMenuRef, iClose);

    if (((*docStrucHdl)->pictureHdl || (*docStrucHdl)->textHdl) && ((*docStrucHdl)->selectFlag))
    {
        EnableMenuItem(editMenuRef, iCut);
        EnableMenuItem(editMenuRef, iCopy);
        EnableMenuItem(editMenuRef, iClear);
    }
    else
    {
        DisableMenuItem(editMenuRef, iCut);
        DisableMenuItem(editMenuRef, iCopy);
        DisableMenuItem(editMenuRef, iClear);
    }

    GetCurrentScrap(&scrapRef);

    osError = GetScrapFlavorFlags(scrapRef, kScrapFlavorTypeText, &scrapFlavorFlags);
    if (osError == noErr)
        scrapHasText = true;

    osError = GetScrapFlavorFlags(scrapRef, kScrapFlavorTypePicture, &scrapFlavorFlags);
    if (osError == noErr)
        scrapHasPicture = true;

    if ((scrapHasText || scrapHasPicture) && ((*docStrucHdl)->windowType != kClipboardType))
        EnableMenuItem(editMenuRef, iPaste);
    else
        DisableMenuItem(editMenuRef, iPaste);

    DrawMenuBar();
}
```

```
// ***** doMenuChoice
```

```
void doMenuChoice(MenuID menuID,MenuItemIndex menuItem)
```

```
{
    if(menuID == 0)
        return;

    switch(menuID)
    {
        case mAppleApplication:
            if(menuItem == iAbout)
                SysBeep(10);
            break;

        case mFile:
            if(menuItem == iClose)
                doCloseWindow();
            break;

        case mEdit:
            switch(menuItem)
            {
                case iCut:
                    doCutCopyCommand(true);
                    break;

                case iCopy:
                    doCutCopyCommand(false);
                    break;

                case iPaste:
                    doPasteCommand();
                    break;

                case iClear:
                    doClearCommand();
                    break;

                case iClipboard:
                    doClipboardCommand();
                    break;
            }
            break;
    }
}
```

```
// ***** doErrorAlert
```

```
void doErrorAlert(SInt16 errorCode)
```

```
{
    Str255 errorString;
    SInt16 itemHit;
```

```

    GetIndString(errorString,rErrorStrings,errorCode);
    StandardAlert(kAlertStopAlert,errorString,NULL,NULL,&itemHit);
    ExitToShell();
}

// ***** doOpenDocumentWindows

void doOpenDocumentWindows(void)
{
    SInt16          a;
    OSStatus        osError;
    WindowRef       windowRef;
    Rect            contentRect = { 43,7,223,297 }, theRect;
    Str255          title1      = "\pDocument A";
    Str255          title2      = "\pDocument B";
    docStructureHandle docStrucHdl;
    EventTypeSpec    windowEvents[] = { { kEventClassWindow, kEventWindowDrawContent },
                                         { kEventClassWindow, kEventWindowClickContentRgn } };

    for(a=0;a<2;a++)
    {
        osError = CreateNewWindow(kDocumentWindowClass,kWindowStandardHandlerAttribute,
                                &contentRect,&windowRef);

        if(osError != noErr)
            doErrorAlert(eFailWindow);

        if(a == 0)
        {
            SetWTitle(windowRef,"\pDocument A");
            OffsetRect(&contentRect,305,0);
        }
        else
            SetWTitle(windowRef,"\pDocument B");

        if(!(docStrucHdl = (docStructureHandle) NewHandle(sizeof(docStructure))))
            doErrorAlert(eFailDocStruc);
        SetWRefCon(windowRef,(SInt32) docStrucHdl);

        (*docStrucHdl)->pictureHdl = NULL;
        (*docStrucHdl)->textHdl    = NULL;
        (*docStrucHdl)->windowType = kDocumentType;
        (*docStrucHdl)->selectFlag = false;

        SetPortWindowPort(windowRef);

        if(gRunningOnX)
        {
            GetWindowPortBounds(windowRef,&theRect);
            InsetRect(&theRect,40,40);
            ClipRect(&theRect);
        }
        else
            UseThemeFont(kThemeSmallSystemFont,smSystemScript);
    }
}

```

```

    if(a == 0)
        (*docStrucHdl)->textHdl = (Handle) GetResource('TEXT',rText);
    else
        (*docStrucHdl)->pictureHdl = GetPicture(rPicture);

    InstallWindowEventHandler(windowRef,doGetHandlerUPP(),GetEventTypeCount(windowEvents),
                            windowEvents,0,NULL);

    ShowWindow(windowRef);
}
}

// ***** doGetHandlerUPP

EventHandlerUPP doGetHandlerUPP(void)
{
    static EventHandlerUPP windowEventHandlerUPP;

    if(windowEventHandlerUPP == NULL)
        windowEventHandlerUPP = NewEventHandlerUPP((EventHandlerProcPtr) docWindowEventHandler);

    return windowEventHandlerUPP;
}

// ***** doCloseWindow

void doCloseWindow(void)
{
    WindowRef      windowRef;
    docStructureHandle docStrucHdl;
    MenuRef        editMenuRef;

    windowRef = FrontWindow();
    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

    if((*docStrucHdl)->windowType == kClipboardType)
    {
        DisposeWindow(windowRef);
        gClipboardWindowRef = NULL;
        gClipboardShowing = false;
        editMenuRef = GetMenuRef(mEdit);
        SetMenuItemText(editMenuRef,iClipboard,"\pShow Clipboard");
    }
}

// ***** doInContent

void doInContent(Point mouseLocation)
{
    WindowRef      windowRef;
    docStructureHandle docStrucHdl;
    GrafPtr        oldPort;
    Rect            theRect;

```

```

windowRef = FrontWindow();
docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

if((*docStrucHdl)->windowType == kClipboardType)
    return;

GetPort(&oldPort);
SetPortWindowPort(windowRef);

if((*docStrucHdl)->textHdl != NULL || (*docStrucHdl)->pictureHdl != NULL)
{
    if((*docStrucHdl)->textHdl != NULL)
    {
        GetWindowPortBounds(windowRef,&theRect);
        InsetRect(&theRect,40,40);
    }
    else if((*docStrucHdl)->pictureHdl != NULL)
    {
        theRect = doSetDestRect(&((*docStrucHdl)->pictureHdl)->picFrame,windowRef);
    }

    if(PtInRect(mouseLocation,&theRect) && (*docStrucHdl)->selectFlag == false)
    {
        (*docStrucHdl)->selectFlag = true;
        InvertRect(&theRect);
    }
    else if(!PtInRect(mouseLocation,&theRect) && (*docStrucHdl)->selectFlag == true)
    {
        (*docStrucHdl)->selectFlag = false;
        InvertRect(&theRect);
    }
}

SetPort(oldPort);
}

// ***** doCutCopyCommand

void doCutCopyCommand(Boolean cutFlag)
{
    WindowRef      windowRef;
    docStructureHandle docStrucHdl;
    OSStatus        osError;
    ScrapRef        scrapRef;
    Size            dataSize;
    GrafPtr         oldPort;
    Rect            portRect;

    windowRef = FrontWindow();
    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

    if((*docStrucHdl)->selectFlag == false)
        return;

```

```

osError = ClearCurrentScrap();
if(osError == noErr)
{
    GetCurrentScrap(&scrapRef);

    if((*docStrucHdl)->textHdl != NULL) // ..... 'TEXT'
    {
        dataSize = GetHandleSize((Handle) (*docStrucHdl)->textHdl);
        HLock((Handle) (*docStrucHdl)->textHdl);

        osError = PutScrapFlavor(scrapRef, kScrapFlavorTypeText, kScrapFlavorMaskNone,
                                dataSize, *((Handle) (*docStrucHdl)->textHdl));
        if(osError != noErr)
            doErrorAlert(ePutScrapFlavor);
    }
    else if((*docStrucHdl)->pictureHdl != NULL) // ..... 'PICT'
    {
        dataSize = GetHandleSize((Handle) (*docStrucHdl)->pictureHdl);
        HLock((Handle) (*docStrucHdl)->pictureHdl);

        osError = PutScrapFlavor(scrapRef, kScrapFlavorTypePicture, kScrapFlavorMaskNone,
                                dataSize, *((Handle) (*docStrucHdl)->pictureHdl));
        if(osError != noErr)
            doErrorAlert(ePutScrapFlavor);
    }

    if((*docStrucHdl)->textHdl != NULL)
        HUnlock((Handle) (*docStrucHdl)->textHdl);
    if((*docStrucHdl)->pictureHdl != NULL)
        HUnlock((Handle) (*docStrucHdl)->pictureHdl);
}
else
    doErrorAlert(eClearScrap);

if(cutFlag)
{
    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    if((*docStrucHdl)->pictureHdl != NULL)
    {
        DisposeHandle((Handle) (*docStrucHdl)->pictureHdl);
        (*docStrucHdl)->pictureHdl = NULL;
        (*docStrucHdl)->selectFlag = false;
    }
    if((*docStrucHdl)->textHdl != NULL)
    {
        DisposeHandle((Handle) (*docStrucHdl)->textHdl);
        (*docStrucHdl)->textHdl = NULL;
        (*docStrucHdl)->selectFlag = false;
    }

    GetWindowPortBounds(windowRef, &portRect);
    EraseRect(&portRect);
}

```



```

        SetPort(oldPort);
    }

    if(gClipboardWindowRef != NULL)
        doDrawClipboardWindow();
}

// ***** doPasteCommand

void doPasteCommand(void)
{
    WindowRef          windowRef;
    docStructureHandle docStrucHdl;
    GrafPtr            oldPort;
    ScrapRef           scrapRef;
    OSStatus           osError;
    ScrapFlavorFlags   flavorFlags;
    Size               sizeOfPictData = 0, sizeOfTextData = 0;
    Handle             newTextHdl, newPictHdl;
    CFStringRef         stringRef;
    Rect               destRect, portRect;

    windowRef = FrontWindow();
    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    GetCurrentScrap(&scrapRef);

    // ..... 'TEXT'

    osError = GetScrapFlavorFlags(scrapRef, kScrapFlavorTypeText, &flavorFlags);
    if(osError == noErr)
    {
        osError = GetScrapFlavorSize(scrapRef, kScrapFlavorTypeText, &sizeOfTextData);
        if(osError == noErr && sizeOfTextData > 0)
        {
            newTextHdl = NewHandle(sizeOfTextData);
            osError = MemError();
            if(osError == memFullErr)
                doErrorAlert(eFailMemory);

            HLock(newTextHdl);

            osError = GetScrapFlavorData(scrapRef, kScrapFlavorTypeText, &sizeOfTextData, *newTextHdl);
            if(osError != noErr)
                doErrorAlert(eGetScrapData);

            // ..... draw text in window

            GetWindowPortBounds(windowRef, &portRect);
            EraseRect(&portRect);
            InsetRect(&portRect, 40, 40);

```

```

if(!gRunningOnX)
{
    TETextBox(*newTextHdl, sizeofTextData, &portRect, teFlushLeft);
}
else
{
    stringRef = CFStringCreateWithBytes(NULL, (UInt8 *) *newTextHdl, sizeofTextData,
                                       smSystemScript, false);
    DrawThemeTextBox(stringRef, kThemeSmallSystemFont, kThemeStateActive, true, &portRect,
                    teFlushLeft, NULL);
    if(stringRef != NULL)
        CFRelease(stringRef);
}

HUnlock(newTextHdl);

(*docStrucHdl)->selectFlag = false;

// ..... assign handle to new text to window's document structure

if((*docStrucHdl)->textHdl != NULL)
    DisposeHandle((*docStrucHdl)->textHdl);
(*docStrucHdl)->textHdl = newTextHdl;

if((*docStrucHdl)->pictureHdl != NULL)
    DisposeHandle((Handle) (*docStrucHdl)->pictureHdl);
(*docStrucHdl)->pictureHdl = NULL;
}
else
    doErrorAlert(eGetScrapSize);
}

// ..... ' PICT'

else
{
    (osError = GetScrapFlavorFlags(scrapRef, kScrapFlavorTypePicture, &flavorFlags));
    if(osError == noErr)
    {
        osError = GetScrapFlavorSize(scrapRef, kScrapFlavorTypePicture, &sizeofPictData);
        if(osError == noErr && sizeofPictData > 0)
        {
            newPictHdl = NewHandle(sizeofPictData);
            osError = MemError();
            if(osError == memFullErr)
                doErrorAlert(eFailMemory);

            HLock(newPictHdl);

            osError = GetScrapFlavorData(scrapRef, kScrapFlavorTypePicture, &sizeofPictData,
                                       *newPictHdl);
            if(osError != noErr)
                doErrorAlert(eGetScrapData);
        }
    }
}

```

```

// ..... draw picture in window

GetWindowPortBounds(windowRef,&portRect);
EraseRect(&portRect);
(*docStrucHdl)->selectFlag = false;
destRect = doSetDestRect(&((PicHandle) newPictHdl)->picFrame,windowRef);
DrawPicture((PicHandle) newPictHdl,&destRect);

HUnlock(newPictHdl);

(*docStrucHdl)->selectFlag = false;

// ..... assign handle to new picture to window's document structure

if((*docStrucHdl)->pictureHdl != NULL)
    DisposeHandle((Handle) (*docStrucHdl)->pictureHdl);
(*docStrucHdl)->pictureHdl = (PicHandle) newPictHdl;

if((*docStrucHdl)->textHdl != NULL)
    DisposeHandle((Handle) (*docStrucHdl)->textHdl);
(*docStrucHdl)->textHdl = NULL;
}
else
    doErrorAlert(eGetScrapSize);
}
}

SetPort(oldPort);
}

// ***** doClearCommand

void doClearCommand(void)
{
    WindowRef        windowRef;
    docStructureHandle docStrucHdl;
    GrafPtr           oldPort;
    Rect              portRect;

    windowRef = FrontWindow();
    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    if((*docStrucHdl)->textHdl != NULL)
    {
        DisposeHandle((*docStrucHdl)->textHdl);
        (*docStrucHdl)->textHdl = NULL;
    }
}

```

```

if ((*docStrucHdl)->pictureHdl != NULL)
{
    DisposeHandle((Handle) (*docStrucHdl)->pictureHdl);
    (*docStrucHdl)->pictureHdl = NULL;
}

(*docStrucHdl)->selectFlag = false;

GetWindowPortBounds(windowRef,&portRect);
EraseRect(&portRect);

SetPort(oldPort);
}

// ***** doClipboardCommand

void doClipboardCommand(void)
{
    MenuRef          editMenuRef;
    OSStatus          osError;
    Rect             contentRect = { 254,7,384,603 };
    docStructureHandle docStrucHdl;
    EventTypeSpec     windowEvents[] = { { kEventClassWindow, kEventWindowActivated },
                                           { kEventClassWindow, kEventWindowDeactivated },
                                           { kEventClassWindow, kEventWindowDrawContent },
                                           { kEventClassWindow, kEventWindowClose } };

    editMenuRef = GetMenuRef(mEdit);

    if (gClipboardWindowRef == NULL)
    {
        osError = CreateNewWindow(kDocumentWindowClass, kWindowStandardHandlerAttribute |
                                   kWindowCloseBoxAttribute, &contentRect, &gClipboardWindowRef);
        if (osError != noErr)
            doErrorAlert(eFailWindow);

        SetWTitle(gClipboardWindowRef, "\pClipboard");
        SetPortWindowPort(gClipboardWindowRef);

        if (!(docStrucHdl = (docStructureHandle) NewHandle(sizeof(docStructure))))
            doErrorAlert(eFailDocStruc);

        SetWRefCon(gClipboardWindowRef, (SInt32) docStrucHdl);
        (*docStrucHdl)->windowType = kClipboardType;

        SetMenuItemText(editMenuRef, iClipboard, "\pHide Clipboard");

        InstallWindowEventHandler(gClipboardWindowRef,
                                   NewEventHandlerUPP((EventHandlerProcPtr) clipWindowEventHandler),
                                   GetEventTypeCount(windowEvents), windowEvents, 0, NULL);

        ShowWindow(gClipboardWindowRef);
        gClipboardShowing = true;
    }
}

```

```

else
{
    if(gClipboardShowing)
    {
        HideWindow(gClipboardWindowRef);
        gClipboardShowing = false;
        SetMenuItemText(editMenuRef,iClipboard,"\pShow Clipboard");
    }
    else
    {
        ShowWindow(gClipboardWindowRef);
        gClipboardShowing = true;
        SetMenuItemText(editMenuRef,iClipboard,"\pHide Clipboard");
    }
}
}

// ***** doDrawClipboardWindow

void doDrawClipboardWindow(void)
{
    GrafPtr      oldPort;
    Rect          theRect, textBoxRect;
    ScrapRef      scrapRef;
    OSStatus      osError;
    ScrapFlavorFlags flavorFlags;
    CFStringRef    stringRef;
    Handle         tempHdl;
    Size           sizeOfPictData = 0, sizeOfTextData = 0;
    RGBColor       blackColor = { 0x0000, 0x0000, 0x0000 };

    GetPort(&oldPort);
    SetPortWindowPort(gClipboardWindowRef);

    GetWindowPortBounds(gClipboardWindowRef,&theRect);
    EraseRect(&theRect);

    SetRect(&theRect, -1, -1, 597, 24);
    DrawThemeWindowHeader(&theRect,gClipboardWindowRef == FrontWindow());

    if(gClipboardWindowRef == FrontWindow())
        TextMode(srcOr);
    else
        TextMode(grayishTextOr);

    SetRect(&textBoxRect, 10, 5, 120, 20);
    DrawThemeTextBox(CFSTR("Clipboard Contents:"),kThemeSmallSystemFont,0,true,&textBoxRect,
        teJustLeft,NULL);

    GetCurrentScrap(&scrapRef);

```

```
// ..... 'TEXT'

osError = GetScrapFlavorFlags(scrapRef, kScrapFlavorTypeText, &flavorFlags);
if(osError == noErr)
{
    osError = GetScrapFlavorSize(scrapRef, kScrapFlavorTypeText, &sizeOfTextData);
    if(osError == noErr && sizeOfTextData > 0)
    {
        SetRect(&textBoxRect, 120, 5, 597, 20);
        DrawThemeTextBox(CFSTR("Text"), kThemeSmallSystemFont, 0, true, &textBoxRect, teJustLeft,
            NULL);

        tempHdl = NewHandle(sizeOfTextData);
        osError = MemError();
        if(osError == memFullErr)
            doErrorAlert(eFailMemory);

        HLock(tempHdl);

        osError = GetScrapFlavorData(scrapRef, kScrapFlavorTypeText, &sizeOfTextData, *tempHdl);
        if(osError != noErr)
            doErrorAlert(eGetScrapData);

        // ..... draw text in clipboard window

        GetWindowPortBounds(gClipboardWindowRef, &theRect);
        theRect.top += 22;
        InsetRect(&theRect, 2, 2);

        if(sizeOfTextData >= 965)
            sizeOfTextData = 965;
        stringRef = CFStringCreateWithBytes(NULL, (UInt8 *) *tempHdl, sizeOfTextData,
            CFStringGetSystemEncoding(), true);
        DrawThemeTextBox(stringRef, kThemeSmallSystemFont, 0, true, &theRect, teFlushLeft, NULL);
        if(stringRef != NULL)
            CFRelease(stringRef);

        HUnlock(tempHdl);
        DisposeHandle(tempHdl);
    }
    else
        doErrorAlert(eGetScrapSize);
}

// ..... 'PICT'

else
{
    osError = GetScrapFlavorFlags(scrapRef, kScrapFlavorTypePicture, &flavorFlags);
    if(osError == noErr)
    {
        osError = GetScrapFlavorSize(scrapRef, kScrapFlavorTypePicture, &sizeOfPictData);
        if(osError == noErr && sizeOfPictData > 0)
```

```

    {
        SetRect(&textBoxRect,120,5,597,20);
        DrawThemeTextBox(CFSTR("Picture"),kThemeSmallSystemFont,0,true,&textBoxRect,
                        teJustLeft,NULL);

        tempHdl = NewHandle(sizeofPictData);
        osError = MemError();
        if(osError == memFullErr)
            doErrorAlert(eFailMemory);

        HLock(tempHdl);

        osError = GetScrapFlavorData(scrapRef,kScrapFlavorTypePicture,&sizeofPictData,
                                    *tempHdl);

        if(osError != noErr)
            doErrorAlert(eGetScrapData);

        // ..... draw picture in clipboard window

        theRect = (*(PicHandle) tempHdl)->picFrame;
        OffsetRect(&theRect,-((*(PicHandle) tempHdl)->picFrame.left - 2),
                  -((*(PicHandle) tempHdl)->picFrame.top - 26));
        DrawPicture((PicHandle) tempHdl,&theRect);

        HUnlock(tempHdl);
        DisposeHandle(tempHdl);
    }
    else
        doErrorAlert(eGetScrapSize);
}

}

TextMode(srcOr);
SetPort(oldPort);
}

// ***** doDrawDocumentWindow

void doDrawDocumentWindow(WindowRef windowRef)
{
    GrafPtr      oldPort;
    docStructureHandle docStrucHdl;
    Rect         destRect;
    CFStringRef   stringRef;

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

    if((*docStrucHdl)->textHdl != NULL)
    {
        GetWindowPortBounds(windowRef,&destRect);
        EraseRect(&destRect);
        InsetRect(&destRect,40,40);
    }
}

```

```

    stringRef = CFStringCreateWithBytes(NULL, (UInt8 *)>(*docStrucHdl)->textHdl,
                                       GetHandleSize((*docStrucHdl)->textHdl),
                                       smSystemScript, false);
    DrawThemeTextBox(stringRef, kThemeSmallSystemFont, 0, true, &destRect, teFlushLeft, NULL);
    if(stringRef != NULL)
        CFRelease(stringRef);

    if((*docStrucHdl)->selectFlag)
        InvertRect(&destRect);
}
else if((*docStrucHdl)->pictureHdl != NULL)
{
    destRect = doSetDestRect(&(*docStrucHdl)->pictureHdl->picFrame, windowRef);
    DrawPicture((*docStrucHdl)->pictureHdl, &destRect);
    if((*docStrucHdl)->selectFlag)
        InvertRect(&destRect);
}

SetPort(oldPort);
}

// ***** doSetDestRect

Rect doSetDestRect(Rect *picFrame, WindowRef windowRef)
{
    Rect    destRect, portRect;
    SInt16 diffX, diffY;

    destRect = *picFrame;
    GetWindowPortBounds(windowRef, &portRect);

    OffsetRect(&destRect, -(*picFrame).left, -(*picFrame).top);

    diffX = (portRect.right - portRect.left) - ((*picFrame).right - (*picFrame).left);
    diffY = (portRect.bottom - portRect.top) - ((*picFrame).bottom - (*picFrame).top);

    OffsetRect(&destRect, diffX / 2, diffY / 2);

    return destRect;
}

// *****

```

## Demonstration Program CarbonScrap Comments

When this program is run, the user should choose the Edit menu's Show Clipboard item to open the Clipboard window. The user should then cut, copy, clear, and paste the supplied text or picture from/to the two document windows opened by the program, noting the effect on the scrap as displayed in the Clipboard window. (To indicate selection, the text or picture inverts when the user clicks on it with the mouse. The text and picture can be deselected by clicking outside their boundaries.)



The user should also copy text and pictures from another application's window, observing the changes to the contents of the Clipboard window when the demonstration program is brought to the front, and paste that text and those pictures to the document windows. (On Mac OS 8/9, a simple way to get a picture into the scrap is to use Command-Shift-Control-4 to copy an area of the screen to the scrap.)

The program's preferred scrap flavor type is 'TEXT'. Thus, if the scrap contains data in both the 'TEXT' and 'PICT' flavor types, only the 'TEXT' flavor will be used for pastes to the document windows and for display in the Clipboard window. The user can prove this behavior by copying a picture object containing text in an application such as Adobe Illustrator, bringing the demonstration program to the front, noting the contents of the Clipboard window, pasting to one of the document windows, and noting what is pasted.

The user should note that, when the Clipboard window is open and showing, it will be hidden when the program is sent to the background and shown again when the program is brought to the foreground.

### **defines**

kDocumentType and kClipboardType will enable the program to distinguish between the "document" windows opened by the program and the Clipboard window.

### **typedefs**

Document structures will be attached to the two document windows and the Clipboard window. docStructure is the associated data type. The windowType field will be used to differentiate between the document windows and the Clipboard window.

### **Global Variables**

gClipboardWindowRef will be assigned a reference to the Clipboard window when it is opened by the user. gClipboardShowing will keep track of whether the Clipboard window is currently hidden or showing.

### **appEventHandler**

When the kEventAppActivated event type is received, if the Clipboard window has been opened and was showing when the program was sent to the background, ShowWindow is called to show the Clipboard window. When the kEventAppActivated event type is received, if the Clipboard window has been opened and is currently showing, ShowHide is called to hide the Clipboard window. ShowHide, rather than HideWindow is used in this instance to prevent activation of the first document window in the list when the Clipboard window is in front and the application is switched out.

### **windowEventHandler**

`windowEventHandler` is the handler for the document windows. When the `kEventWindowClickContentRegion` event type is received, the function `doInContent` is called.

### **clipWindowEventHandler**

`clipWindowEventHandler` is the handler for the Clipboard window. The function `doDrawClipboardWindow` is called when the window receives the event types `kEventWindowActivated`, `kEventWindowDeactivated`, `kEventWindowDrawContent` are received. When the `kEventWindowClose` event type is received, the Clipboard window is disposed of and the text of its item in the Edit menu is changed.

### **doAdjustMenus**

If the front window is the Clipboard window, the Close item is enabled, otherwise it is disabled. If the document contains a picture and that picture is currently selected, the Cut, Copy, and Clear items are enabled, otherwise they are disabled.

If the scrap contains data of flavor type 'PICT' or flavor type 'TEXT', and the front window is not the Clipboard window, the Paste item is enabled, otherwise it is disabled. In this section, `GetCurrentScrap` is called to obtain a reference to the current scrap. This reference is then passed in two calls to `GetScrapFlavorFlags`, which determine whether the scrap contains data of the flavor type 'PICT' and/or flavor type 'TEXT'. If it does, and if the front window is not the Clipboard window, the Paste item is enabled.

### **doOpenDocumentWindows**

`doOpenDocumentWindows` opens the two document windows, creates document structures for each window, attaches the document structures to the windows and initializes the fields of the document structures.

The `textHdl` field of the first window's document structure is assigned a handle to a 'TEXT' resource and the `textHdl` field of the second window's document structure is assigned a handle to a 'PICT' resource.

### **doCloseWindow**

`doCloseWindow` closes the Clipboard window (the only window that can be closed from within the program).

If the window is the Clipboard window, the window is disposed of, the global variable that contains its reference is set to NULL, the global variable which keeps track of whether the window is showing or hidden is set to false, and the text of the Show/Hide Clipboard menu item is set to "Show Clipboard".

### **doInContent**

`doInContent` handles mouse-down events in the content region of a document window. If the window contains text or a picture, and if the mouse-down was inside the text or picture, the text or picture is selected. If the window contains a text or picture, and if the mouse-down was outside the text or picture, the text or picture is deselected.

The first two lines get a reference to the front window and a handle to its document structure. If the front window is the Clipboard window, the function returns immediately.

### **doCutCopyCommand**

`doCutCopyCommand` handles the user's choice of the Cut and Copy items in the Edit menu.

The first two lines get a reference to the front window and a handle to that window's document structure.

If the `selectFlag` field of the document structure contains false (meaning that the text or picture has not been selected), the function returns immediately. (Note that no check is made as to whether the front window is the Clipboard window because the menu adjustment function disables the Cut and Copy items when the Clipboard window is the front window, meaning that this function can never be called when the Clipboard window is in front.)

`ClearCurrentScrap` attempts to clear the current scrap. (This call should always be made immediately the user chooses Cut or Copy.) If the call is successful, `GetCurrentScrap` then gets a reference to the scrap.

If the selected item is text, `GetHandleSize` gets the size of the text from the window's document structure. (In a real application, code which gets the size of the selection would appear here.) `PutScrapFlavor` copies the "selected" text to the scrap. If the call to `PutScrapFlavor` is not successful, an alert is displayed to advise the user of the error.

If the selected item is a picture, `GetHandleSize` gets the size of the picture from the window's document structure. `PutScrapFlavor` copies the selected picture to the scrap. If the call to `PutScrapFlavor` is not successful, an alert is displayed to advise the user of the error.

If the menu choice was the Cut item, additional action is taken. Preparatory to a call to `EraseRect`, the current graphics port is saved and the front window's port is made the current port. `DisposeHandle` is called to dispose of the text or picture and the document structure's `textHdl` or `pictureHdl` field, and `selectFlag` field, are set to NULL and false respectively. `EraseRect` then erases the port rectangle. (In a real application, the action taken in this block would be to remove the selected text or picture from the document.)

Finally, if the Clipboard window has previously been opened by the user, `doDrawClipboardWindow` is called to draw the current contents of the scrap in the Clipboard window.

## doPasteCommand

doPasteCommand handles the user's choice of the Paste item from the Edit menu. Note that no check is made as to whether the front window is the Clipboard window because the menu adjustment function disables the Paste item when the Clipboard window is the front window, meaning that this function can never be called when the Clipboard window is in front.

GetCurrentScrap gets a reference to the scrap.

The first call to GetScrapFlavorFlags determines whether the scrap contains data of flavor type 'TEXT'. If so, GetScrapFlavorSize is called to get the size of the 'TEXT' data.

NewHandle creates a relocatable block of a size equivalent to the 'TEXT' data.

GetScrapFlavorData is called to copy the 'TEXT' data in the scrap to this block.

TETextBox or DrawThemeTextBox is called to draw the text in a rectangle equal to the port rectangle minus 40 pixels all round. If the textHdl field of the window's document structure does not contain NULL, the associated block is disposed of, following which the handle to the block containing the new 'TEXT' data is then assigned to the textHdl field. (In a real application, this block would copy the text into the document at the insertion point. The last three lines in this section simply ensure that, if the window's "document" contains text, it cannot also contain a picture. This is to prevent a picture overdrawing the text when the window contents are updated.)

If the scrap does not contain data of flavor type 'TEXT', GetScrapFlavorFlags is called again to determine whether the scrap contains data of flavor type 'PICT'. If it does, much the same procedure is followed, except that rectangle in which the picture is drawn is extracted from the 'PICT' data itself and adjusted to the middle of the window via a call to the function doSetDestRec.

It is emphasized that the scrap is only checked for flavor type 'PICT' if the scrap does not contain flavor type 'TEXT'. Thus, if both flavors exist in the scrap, only the 'TEXT' flavor will be used to draw the Clipboard.

## doClearCommand

doClearCommand handles the user's choice of the Clear item in the Edit menu.

Note that no check is made as to whether the front window is the Clipboard window because the menu adjustment function disables the Clear item when the Clipboard window is the front window.

If the front window's document structure indicates that the window contains text or a picture, the block containing the TextEdit structure or Picture structure is disposed of and the relevant field of the document structure is set to NULL. In addition, the selectFlag field of the document structure is set to false and the window's port rectangle is erased.

### **doClipboardCommand**

`doClipboardCommand` handles the user's choice of the Show/Hide Clipboard item in the Edit menu.

The first line gets a reference to the Edit menu. This will be required in order to toggle the Show/Hide Clipboard item's text between Show Clipboard and Hide Clipboard.

The if statement checks whether the Clipboard window has been created. If not, the Clipboard window is created by the call to `GetNewCWindow`, a document structure is created and attached to the window, the `windowType` field of the document structure is set to indicate that the window is of the Clipboard type, the Show/Hide Clipboard menu item text is set, the window's special window event handler is installed, the window is shown, and a global variable which keeps track of whether the Clipboard window is currently showing or hidden is set to true.

If the Clipboard window has previously been created, and if the window is currently showing, the window is hidden, the Clipboard-showing flag is set to false, and the Show/Hide Clipboard item's text is set to "Show Clipboard". If the window is not currently showing, the window is made visible, the Clipboard-showing flag is set to true, and the Show/Hide Clipboard item's text is set to "Hide Clipboard".

### **doDrawClipboardWindow**

`doDrawClipboardWindow` draws the contents of the scrap in the Clipboard window. It supports the drawing of both 'PICT' and 'TEXT' flavor type data.

The first four lines save the current graphics port, make the Clipboard window's graphics port the current graphics port and erase the window's content region.

`DrawThemeWindowHeader` draws a window header in the top of the window. Text describing the type of data in the scrap will be drawn in this header.

The text mode for text drawing is set at the next four lines, following which "Clipboard Contents:" is drawn in the header.

The code for getting a reference to the current scrap, checking for the 'TEXT' and 'PICT' flavor types, getting the flavor size, getting the flavor data, and drawing the text and picture in the window is much the same as in the function `doPasteCommand`. The differences are: the rectangle in which the text is drawn is the port rectangle minus two pixels all round and with the top further adjusted downwards by the height of the window header; the left/top of the rectangle in which the picture is drawn is two pixels inside the left side of the content region and two pixels below the window header respectively; the words "Text" or "Picture" are drawn in the window header as appropriate.

Note that, as was the case in the function `doPasteCommand`, the scrap is only checked for flavor type 'PICT' if the scrap does not contain flavor type 'TEXT'. Thus, if both flavors exist in the scrap, only the 'TEXT' flavor will be used to draw the Clipboard.

**doDrawDocumentWindow**

`doDrawDocumentWindow` draws the text or picture belonging to that window in the window. It is called when the `kEventWindowDrawContent` event type is received for the window.





# Text, Textedit, Dates, Times, and Numbers

## CHAPTER

# 21

## IN THIS CHAPTER

- Introduction 1134
- More on Text 1134
- Introduction to TextEdit 1139
- Monostyled TextEdit 1145
- Multistyled TextEdit 1151
- Formatting and Displaying Dates, Times, and Numbers 1154
- Main TextEdit Constants, Data Types and Functions 1162
- Main Constants, Data Types and Functions Relating to Dates, Times and Numbers 1165
- Demonstration Program MonoTextEdit Listing 1167
- Demonstration Program MonoTextEdit Comments 1204
- Demonstration Program DateTimeNumbers Listing 1220
- Demonstration Program DateTimeNumbers Comments 1232



## Introduction

The subject of text on the Macintosh is a complex matter involving QuickDraw, TextEdit, the Font Manager, the Text Utilities, the Script Manager, the Text Services Manager, Apple Type Services for Unicode Imaging, the Resource Manager, keyboard resources, and international resources. Part of that complexity arises from the fact that the system software supports many different writing systems, including Roman, Chinese, Japanese, Hebrew, and Arabic.

### NOTE

Some of the information in this chapter is valid only in the case of the Roman writing system.

Text on the Macintosh was touched on briefly in Chapter 12, which included descriptions of QuickDraw functions used for drawing text and for setting the font, style, size, and transfer mode. Chapter 15 contained a brief treatment of considerations applying to the printing of text. Chapter 26 addresses the Multilingual Text Engine (MLTE) introduced with Mac OS 9.

This chapter addresses

- TextEdit, which you can use to provide your application with basic text editing and formatting capabilities.

Note that the emphasis in this chapter is on monostyled TextEdit. With Mac OS 9 and the introduction of the Multilingual Text Engine (see Chapter 26), it became all but inconceivable that programmers would ever again use multistyled TextEdit to provide their applications with multistyled text-editing capabilities. In the following, multistyled TextEdit is addressed only to the extent necessary to support an understanding of the display of noneditable multistyled text, as in the Help dialog component of the demonstration program MonoTextEdit associated with this chapter.

- The formatting and display of dates, times, and numbers.

Before addressing those particular subjects, however, a brief overview of various closely related matters is appropriate.

## More on Text

### Characters and Character Sets and Codes

A **character** is a symbol that represents the concept of, for example, a lowercase b, the number 2, or the arithmetic operator +, for example. A collection of characters is called a **character set**. Individual characters within a character set are identified by a **character code**.

The **Apple Standard Roman character set** is the fundamental character set for the Macintosh computer. As shown in Fig 1, it uses all character codes from 0x00 to 0xFF. The Standard Roman character set is actually an extended version of the **ASCII character set**, which uses character codes from 0x00 to 0x7F only, and which is highlighted in Fig 1.

	LOW ASCII RANGE								HIGH ASCII RANGE							
	CONTROL CODES		ROMAN CHARACTERS						SCRIPT-SPECIFIC CHARACTERS							
	0x	1x	2x	3x	4x	5x	6x	7x	8x	9x	Ax	Bx	Cx	Dx	Ex	Fx
x0	nul	dle	sp	0	@	P	`	p	Ä	ê		∞	ı	—	‡	?
x1	soh	DC1	!	1	A	Q	a	q	Å	ë	°	±	ı	--	·	Ò
x2	stx	DC2	“	2	B	R	b	r	Ç	í	¢	≤	¬	“	,	Ú
x3	etx	DC3	#	3	C	S	c	s	É	ì	£	≤	√	“	„	Û
x4	eot	DC4	\$	4	D	T	d	t	Ñ	î	§	¥	f	‘	%	Ü
x5	enq	nak	%	5	E	U	e	u	Ö	ï	•	μ	≈	‘	Â	ı
x6	ack	syn	&	6	F	V	f	v	Ü	ñ	¶	∂	Δ	÷	Ê	^
x7	bel	etb	‘	7	G	W	g	w	á	ó	ß	Σ	«	∅	Á	~
x8	bs	can	(	8	H	X	h	x	à	ò	®	Π	»	ÿ	Ë	-
x9	ht	em	)	9	I	Y	i	y	â	ô	©	π	...	ÿ	È	˘
xA	lf	sub	*	:	J	Z	j	z	ä	ö	™	∫		/	Í	·
xB	vt	esc	+	;	K	[	k	{	ã	õ	’	ª	À		Î	°
xC	ff	fs	,	<	L	\	l		å	ú	“	º	Ã	<	Ï	¸
xD	cr	gs	-	=	M	]	m	}	ç	ù	≠	Ω	Õ	>	Ì	˝
xE	so	rs	.	>	N	^	n	~	é	û	Æ	æ	Œ	fi	Ó	ˆ
xF	si	us	/	?	O	_	o	del	è	ü	Ø	ø	œ	fl	Ô	ˇ

FIG 1 - ASCII CHARACTER SET

## Glyphs

The visual representation of a character on a display device is called a **glyph**. In other words, a glyph is the shape by which a character is represented. A specific character can be represented by many different shapes (that is, glyphs).

Two types of glyphs are used by the Font Manager: **bitmapped glyphs** and glyphs from **outline fonts**. A bitmapped glyph is a bitmap designed at a fixed size for a particular display device. An “outline” is a mathematical description of the glyph in terms of lines and curves, and is used by the Font Manager to create bitmaps at any size for any display device.

## Typefaces

If all glyphs for a character set share certain design characteristics, they form a **typeface**. Typefaces have their own names, such as Arial, Geneva, or Times.

## Styles

A specific variation in a glyphs appearance is called a **style**. On the Macintosh, available styles include plain, bold, italic, underline, outline, shadow, condensed, and extended. QuickDraw can add styles to bitmaps, or fonts can be designed with a specific style, such as Arial Italic.

## Fonts and Font Families

A **font** is a full set of glyphs in a specific typeface and style. All fonts have a font name, such as Arial or Geneva, which is ordinarily the same name as the typeface from which it was derived. Except for fonts not in the plain style, the font's name includes the style (or styles), for example "Palatino Bold Italic."

Fonts on the Macintosh are resources. The resource types are as follows:

- Bitmapped font resources are of type 'FONT' (the original resource type for fonts) and 'NFNT' (bitmapped font). 'FONT' and 'NFNT' resources provide a separate bitmap for each glyph in each style and size.
- Outline font resources are of type 'sfnt'. 'sfnt' resources comprise glyphs in a particular typeface and style.

If multiple fonts of the same typeface are present, the Font Manager groups those fonts into **font families** of resource type 'FOND'. A **font family ID** is the resource ID for a font family.

As an aside, most (though not all) fonts assign glyphs to character codes 0x20 to 0x7F, which visually define the characters associated with those codes. However, there are differences in the glyphs assigned to the high-ASCII range. Indeed, some fonts do not actually include glyphs for all, or part, of the high-ASCII range.

### NOTE

Fonts such as Zapf Dingbats assign glyphs of pictorial symbols to this range, as well as the low-ASCII range.

## Font Measurements

Fonts are either **monospaced** or **proportional**. All glyphs in a monospaced font are the same width. The glyphs in a proportional font have different widths, m being wider than i, for example.

## Base Line, Ascent Line, and Descent Line

Most glyphs in a font sit on an imaginary line called the **base line**. The **ascent line** approximately corresponds with the tops of the uppercase letters of the font. The **descent line** usually corresponds to the bottom of descenders (the tails of glyphs like “j”). See Fig 2.

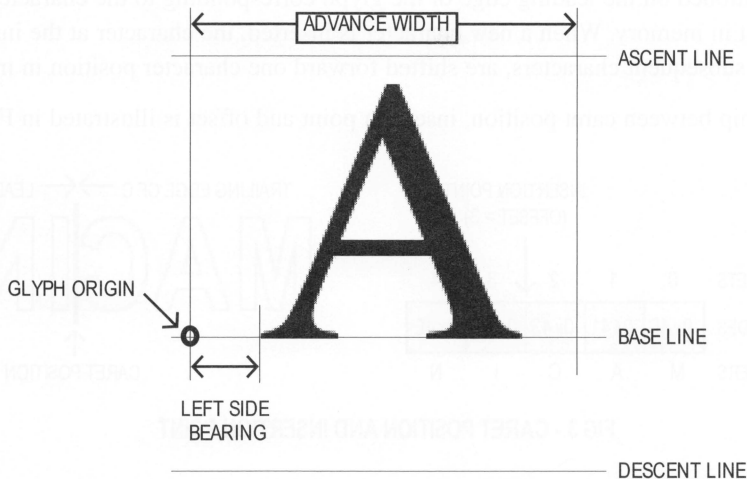


FIG 2 - FONT MEASUREMENT TERMS

## Glyph Origin, Left Side Bearing, and Advance Width

The **glyph origin** is where QuickDraw begins drawing the glyph. The **left side bearing** is the white space between the glyph origin and the beginning of the glyph. The **advance width** is the full width of a glyph, measured from its origin to the origin of the next glyph. See Fig 2.

## Font Size

Font size is the measurement, in **points**, from the base line of one line of text to the base line of the next line (assuming single-spaced text). A point is equivalent to 1/72 of an inch. The size of a font is often, but not always, the sum of the ascent, descent, and **leading** (pronounced “ledding”) values for a font. (The leading is the vertical space between the descent line of one line of single-spaced text and the ascent line of the next line.)

## The Font Manager and QuickDraw

The Font Manager keeps track of all fonts available to an application and supports QuickDraw by providing the character bitmaps that QuickDraw needs. If QuickDraw requests a typeface that is not represented in the available fonts, the Font Manager substitutes one that is. Where necessary, QuickDraw scales the font to the requested size and applies the specified style.

## Caret Position and Text Offset

In the world of text editing, the **caret** is defined as the blinking vertical bar that indicates the **insertion point** in text, and a **caret position** is a location on the screen that corresponds to an insertion point in memory. A caret position is always *between* glyphs on the screen. The caret is always positioned on the leading edge of the glyph corresponding to the character at the insertion point in memory. When a new character is inserted, the character at the insertion point, and all subsequent characters, are shifted forward one character position in memory.

The relationship between caret position, insertion point and offset is illustrated in Fig 3.

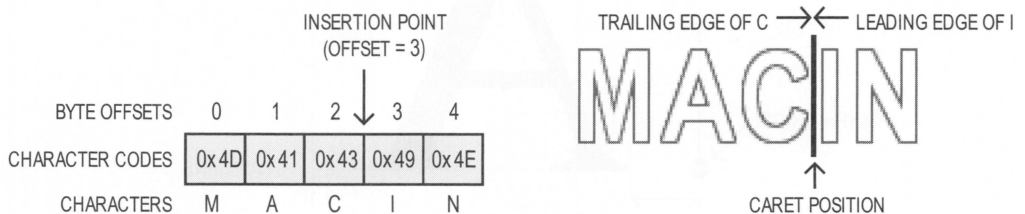


FIG 3 - CARET POSITION AND INSERTION POINT

## Converting Screen Position to Text Offset

A mouse-down event can occur anywhere in a glyph; however, the caret position derived from that mouse-down must be an infinitely thin line between two glyphs.

As shown in Fig 4, a line of glyphs is divided into **mouse-down regions**, which, except at the end of the line, extend from the center of one glyph to the center of the next glyph. A click anywhere in a particular mouse-down region yields the same caret position.

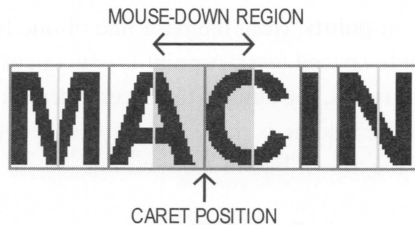


FIG 4 - INTERPRETING CARET POSITION FROM A MOUSE-DOWN EVENT

## Selection Range and Insertion Points

The **selection range** is the sequence of zero or more contiguous characters where the next text editing operation is to occur. If a selection range contains zero characters, it is called an **insertion point**.

## Highlighting

A selection range is typically marked by **highlighting**—that is, by drawing the glyphs with a colored background. The limits of highlighting rectangles are measured in terms of caret position. For example, if the characters A, C, and I in Fig 3 were highlighted, the highlighting would extend from the leading edge of A (offset = 1) to the leading edge of N (offset = 4).

## Outline Highlighting

**Outline highlighting** is the “framing” of text in the selection range in an inactive window. If there is no selection range, a gray, unblinking caret is displayed.

## Keyboards and Text

Each keypress on a particular keyboard generates a value called a **raw key code**. The keyboard driver which handles the keypress uses the **key-map** ( 'KMAP' ) **resource** to map the raw key code to a keyboard-independent **virtual key code**. It then uses the Event Manager and the **keyboard layout** ( 'KCHR' ) **resource** to convert a virtual keycode into a character code. The character code is passed to your application in the event structure generated by the keypress.

## Introduction to TextEdit

TextEdit is a collection of functions and data structures that you can use for the purposes of basic text formatting and editing. It was originally designed to handle edit text items in dialogs, and was subsequently enhanced to provide some of the more complex capabilities required of a basic text editor. That said, it should be understood that TextEdit was never intended to support all of the basic features generally required of a text editor (for example, tabs) and was never intended to manipulate lengthy text documents in excess of 32 KB. Indeed, the limit for documents created by TextEdit is 32,767 characters.

If you do not need to create large files and only need basic formatting capabilities, TextEdit provides a useful alternative to writing your own specialized text processing functions.

## Editing Tasks Performed by TextEdit

The fundamental editing tasks that TextEdit can perform for your application are as follows:

- Selecting text by clicking and dragging the mouse, selecting words by double-clicking, and extending or shortening selections by Shift-clicking.
- Displaying the caret at the insertion point or highlighting the current text selection, as appropriate.
- Handling line breaking, that is, preventing a word from being split between lines.

- Cutting, copying, and pasting text within your application, and between your application and other applications.
- Managing the use of more than one font, text size, text color, and text style from character to character.

## TextEdit Options

You can use TextEdit at different levels of complexity.

### Using TextEdit Indirectly

For the simplest level of text handling (that is, in dialogs), you need not even call TextEdit directly but rather use the Dialog Manager. The Dialog Manager, in turn, calls TextEdit to edit and display text.

### Displaying Static Text

If you simply want to display one or more lines of static (non-editable) text, you can call TETextBox, which draws your text in the location you specify. TETextBox may be used to display text that you cannot edit. You do not need to create a **TextEdit structure** because TETextBox creates its own TextEdit structure. TETextBox draws the text in a rectangle whose size you specify in the coordinates of the current graphics port. Using the following constants, you can specify how text is aligned in the box:

<i>Constant</i>	<i>Description</i>
teFlushDefault	Default alignment according to primary line direction of the script system. (Left for Roman script system.)
teCenter	Center alignment.
teFlushRight	Right alignment.
teFlushLeft	Left alignment.

### Text Handling—Monostyled Text

If your application requires very basic text handling in a single typeface, style, and size, you probably only need **monostyled TextEdit**. You can use monostyled TextEdit with any single available font.

### Text Handling—Multistyled Text

If your application requires a somewhat higher level of text handling (allowing the user to change typeface, style, and size within the document, for example), you can use **multistyled TextEdit**. However, as previously stated, multistyled TextEdit has now been overshadowed by the introduction of the Multilingual Text Engine.



## Caret Position and Movement in TextEdit

TextEdit always positions the caret where the next editing operation will occur. When TextEdit pastes text, it positions the caret after the newly pasted text. Assuming that the caret is not in the first or last line of text, TextEdit moves the caret up or down one line when the user presses the Up Arrow key or the Down Arrow key. (If the caret is on the first line, TextEdit moves the caret to the beginning of text on that line if the user presses the Up Arrow key. If the caret is on the last line, TextEdit moves the caret to the end of the text on that line if the user presses the Down Arrow key.)

### NOTE

TextEdit does not support the use of modifier keys, such as the Shift key, in conjunction with the arrow keys.

## Automatic Scrolling

One way for the user to select large blocks of text is to click in the text and, holding the mouse button down, drag the cursor above, below, left of, or right of TextEdit's **view rectangle**. While the mouse button remains down, and provided that your application has enabled automatic scrolling, TextEdit continually calls its **click loop function** to automatically scroll the text.

Although TextEdit's default click loop function automatically scrolls the text, it cannot adjust the scroll box/scroller position in an application's scroll bars to follow up the scrolling. The default click loop function can, however, be replaced with an application-defined click loop (callback) function which accommodates scroll bars.

## TextEdit's Private, Null, and Style Scraps

Internally, TextEdit uses three scrap areas, namely, the **private scrap**, the **null scrap**, and the **style scrap**. The null scrap and the style scrap apply only to multistyled TextEdit.

The private scrap, which belongs to your application, is used for all cut, copy, and paste activity.

The null scrap is used by TextEdit to store **character attribute** information associated with a null selection or text that is deleted by backspacing. (A null selection is an insertion point.)

When multistyled text is cut or copied, TextEdit copies character attribute information to the style scrap.



**NOTE**

The font, style, size, and color aspects of text are collectively referred to as **character attributes**.

## Text Alignment

Text **alignment** can be left-aligned, right-aligned, centered, or justified. Justified means aligned with both the left and right edges of TextEdit's **destination rectangle**, and is achieved by spreading or compressing text to fit a given line width.

## Primary TextEdit Data Structures

The primary data structures used by TextEdit are the TextEdit structure and the **dispatch structure**. Additional data structures are associated with multistyled TextEdit. This section describes the primary data structures only.

### The TextEdit Structure

The TextEdit structure is the principal data structure used by TextEdit. This structure is the same regardless of whether the text is monostyled or multistyled, although some fields are used differently for multistyled TextEdit structures. The TextEdit structure is as follows:

```
struct TERec
{
    Rect        destRect;    // Destination rectangle.
    Rect        viewRect;    // View rectangle.
    Rect        selRect;     // Selection rectangle.
    short       lineHeight;  // Vert spacing of lines. -1 in multistyled.
    short       fontAscent;  // Font ascent. -1 in multistyled TextEdit structure.
    Point       selPoint;    // Point selected with the mouse.
    short       selStart;    // Start of selection range.
    short       selEnd;      // End of selection range.
    short       active;      // Set when structure is activated or deactivated.
    WordBreakUPP wordBreak;  // Word break function.
    TEClickLoopUPP clickLoop; // Click loop function.
    long        clickTime;   // (Used internally.)
    short       clickLoc;    // (Used internally.)
    long        caretTime;   // (Used internally.)
    short       caretState;  // (Used internally.)
    short       just;        // Text alignment.
    short       teLength;    // Length of text.
    Handle       hText;       // Handle to text to be edited.
    long        hDispatchRec; // Handle to TextEdit dispatch structure.
    short       clickStuff;   // (Used internally)
    short       crOnly;      // If < 0, new line at Return only.
    short       txFont;      // Text font. // If multistyled edit struct (txSize = -1),
    StyleField  txFace;      // Chara style. // these bytes are used as a handle
    SInt8       filler;      // // to a style structure (TEStyleHandle).
```

```

short      txMode;          // Pen mode.
short      txSize;          // Font size. -1 in multistyled TextEdit structure.
GrafPtr    inPort;         // Pointer to grafPort for this TextEdit structure.
HighHookUPP highHook;      // Used for text highlighting, caret appearance.
CaretHookUPP caretHook;    // Used from assembly language.
short      nLines;         // Number of lines.
short      lineStarts[16001]; // Positions of line starts.
};
typedef struct TEREc TEREc;
typedef TEREc *TEPtr;
typedef TEPtr *TEHandle;

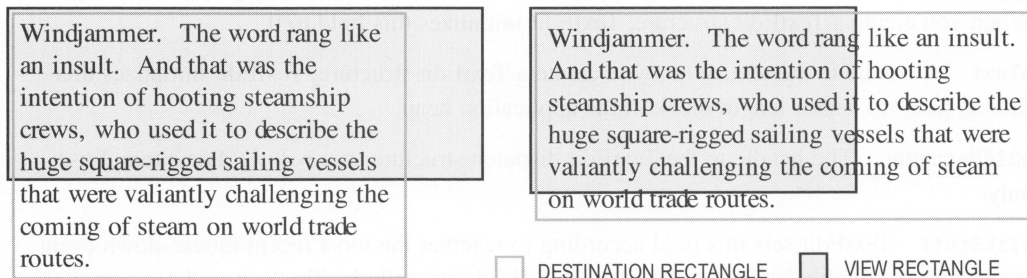
```

## Field Descriptions

**destRect** The destination rectangle (local coordinates), which is the area in which text is drawn (see Fig 5). The top of this rectangle determines the position of the first line of text and the two sides determine the beginning and the end of each line. The bottom of the rectangle varies as text is added or removed as a result of editing operations.

The destination rectangle is central to the matter of scrolling text. When text is scrolled downward; for example, you can think of the destination rectangle as being moved upwards through the view rectangle.

**viewRect** The view rectangle (local coordinates), which is the area in which text is actually displayed (see Fig 5).



**FIG 5 - DESTINATION AND VIEW RECTANGLES**

**selRect** The selection rectangle boundaries (local coordinates).

**lineHeight** In a monostyled TextEdit structure, the vertical spacing of lines of text, that is, the distance from the ascent line of any one line of text to the ascent line of the next line of text. In a multistyled TextEdit structure, this field is set to -1, which indicates that line heights are calculated for each individual line of text.

**fontAscent** In a monostyled TextEdit structure, the font ascent, that is, the vertical distance above the baseline the pen is positioned to begin drawing the caret or selection highlighting. (In the case of single-spaced text, the font ascent is the height of the text in pixels.) In a

multistyled `TextEdit` structure, this field is set to -1, which indicates that font ascent is calculated for each individual line of text.

`selPoint` The point selected with the mouse (local coordinates).

`selStart` The byte offset of the start of the selection range. `TextEdit` initializes this field to 0 when you create a `TextEdit` structure.

`selEnd` The byte offset of the end of the selection range. `TextEdit` initializes this field to 0 when you create a `TextEdit` structure. With both `selStart` and `selEnd` initialized to 0, the insertion point is placed at the beginning of the text.

`active` Set when the `TextEdit` structure is activated and reset when the `TextEdit` structure is rendered inactive.

`wordBreak` Universal procedure pointer to the word selection break function, which determines the word that is highlighted when the user double-clicks in the text and the position at which text is wrapped at the end of the line.

`clickLoop` Universal procedure pointer to the click loop function, which is called repeatedly while the mouse button is held down within the text.

`just` Text alignment (default, left, center, or right).

`teLength` The number of bytes in the text. The maximum allowable length is 32,767 bytes. When you create a `TextEdit` structure, `TextEdit` initializes this field to 0.

`hText` A handle to the text. When you create a `TextEdit` structure, `TextEdit` initializes this field to point to a zero-length block in the application heap.

`hDispatchRec` The handle to the `TextEdit` dispatch structure (see below). For internal use only.

`clickStuff` `TextEdit` sets this field according to whether the most recent mouse-down event occurred on a glyph's leading or trailing edge. Used internally by `TextEdit` to determine a caret position.

`crOnly` If the value in this field is positive, text wraps at the right edge of the destination rectangle. If the value is negative, text does *not* wrap.

`txFont` In a monostyled `TextEdit` structure, the font of all the text in the `TextEdit` structure. (If you change the value, you should also change the `lineHeight` and `fontAscent` fields as appropriate.) In a multistyled `TextEdit` structure, if the `txSize` field (see below) is set to -1, this field combines with `txFace` and `filler` to hold a handle to the associated style structure.

`txFace` In a monostyled `TextEdit` structure, the character attributes of all the text in a `TextEdit` structure. (If you change this value, you should also change the `lineHeight` and `fontAscent` fields as appropriate.) In a multistyled `TextEdit` structure, if the `txSize` field is set

to -1, this field combines with `txFont` and `filler` to hold a handle to the associated style structure.

`txMode` The pen mode of all the text.

`txSize` In a monostyled `TextEdit` structure, this field is set to the size of the text in points. In a multistyled `TextEdit` structure, this field is set to is -1, indicating that the `TextEdit` structure contains associated character attribute information. The `txFont`, `txFace`, and `filler` fields combine to form a handle to the style structure in which this character attribute information is stored.

`inPort` A pointer to the graphics port associated with the `TextEdit` structure.

`highHook` A universal procedure pointer to the function that deals with text highlighting.

`caretHook` Universal procedure pointer to the function that controls the appearance of the caret.

`numLines` The number of lines of text.

`lineStarts` A dynamic array that contains the character position of the first character in each line of the text. This array grows and shrinks, containing only as many elements as needed.

## The Dispatch Structure

The `hDispatchRec` field of the `TextEdit` structure stores a handle to the dispatch structure. The dispatch structure is an internal data structure whose fields contain the addresses of functions that determine the way `TextEdit` behaves. You can modify `TextEdit`'s default behavior by replacing the address of a default function in the dispatch structure with the address of your own customized function.

## Monostyled TextEdit

This section describes the use of `TextEdit` with monostyled text, that is, text with a single typeface, style, and size. Everything in this section also applies to using `TextEdit` with multistyled text except where otherwise indicated.

## Creating, and Disposing of, a Monostyled TextEdit Structure

### Creating a Monostyled TextEdit Structure

To use `TextEdit` functions, you must first create a `TextEdit` structure using `TENew`. `TENew` returns a handle to the newly-created monostyled `TextEdit` structure. You typically store the returned handle in a field of a document structure, the handle to which is typically stored in the application window's `refCon` field.

The required destination and view rectangles are specified in the `TENew` call. You should inset the destination rectangle at least four pixels from the left and right edges of the graphics port, making an additional allowance for scroll bars as appropriate. This will ensure that the first and last glyphs in each line are fully visible. You typically make the view rectangle equal to the destination rectangle. (If you do not want the text to be visible, specify a view rectangle off the screen.)

When a `TextEdit` structure is created, `TextEdit` initializes the `TextEdit` structure's fields based on values in the current graphics port object and on the type of `TextEdit` structure you create.

## Disposing of a TextEdit Structure

Memory allocated for a `TextEdit` structure may be released by calling `TEDispose`.

## Setting the Text

A new `TextEdit` structure does not contain any text until the user either opens an existing document or enters text via the keyboard. The following is concerned with existing documents.

`TESetText` may be used to specify the text to be edited. Alternatively, you can set the `hText` field of the `TextEdit` structure directly.

## Calling TESetText

When a user opens a document, your application can load that document's text and then call `TESetText`. `TESetText` creates a copy of the text and stores the copy in the existing handle of the `TextEdit` structure's `hText` field.

You must pass the length of the text in the call to `TESetText`. `TESetText` uses this to reset the `teLength` field of the `TextEdit` structure, and to set the `selStart` and `selEnd` fields to the last byte offset of the text. `TESetText` also calculates the line breaks.

`TESetText` does not cause the text to be displayed immediately. You must call `InvalWindowRect` to force the text to be displayed at the next update event for the active window.

## Changing the hText Field

The alternative of setting the `hText` field directly, replacing the existing handle with the handle of the new text, saves memory if you have a lot of text. When you use this method, you must also assign the length of the text to the `teLength` field of the `TextEdit` structure and call `TECalcText` to recalculate the `lineStarts` array and `numLines` values.

## Responding to Events

### Activate Events

When your application receives an activate event (Classic event model) or `kEventWindowActivated` or `kEventWindowDeactivated` event type (Carbon event model), it should call `TEActivate` or `TEDeactivate` as appropriate.

A `TextEdit` structure which has been activated by `TEActivate` has its selection highlighted or, if there is no selection, has its caret displayed and blinking at the insertion point. A `TextEdit` structure which has been deactivated by `TEDeactivate` has its selection range outlined (if outline highlighting is enabled) or, if there is no selection, has a gray, unblinking caret displayed at the insertion point.

#### NOTE

Outline highlighting may be activated and deactivated using `TEFeatureFlag`.

Note that when you use `TEClick` and `TESetSelect` to set the selection range or insertion point, the selection range is not highlighted, or the blinking caret is not displayed, until the `TextEdit` structure is activated. (However, if outline highlighting is enabled, the text of the selection range will be framed or a gray, unblinking caret will be displayed.)

### Update Events—Calling `TEUpdate`

When your application receives an update event (Classic event model) or `kEventWindowDrawContent` or `kEventWindowUpdate` event type (Carbon event model), it should call `TEUpdate`. In addition, you should call `TEUpdate` after changing any fields of the `TextEdit` structure, or after any editing or scrolling operation, which alters the onscreen appearance of the text.

### Mouse-Down Events—Calling `TEClick`

On receipt of a mouse-down event that should be handled by `TextEdit`, your application must pass the event to `TEClick`. `TEClick` tells `TextEdit` that a mouse-down event has occurred.

Before calling `TEClick`, however, your application must

- Convert the mouse location from global coordinates to the local coordinates required by `TEClick`.
- Determine if the Shift key was down at the time of the event.

`TEClick` repeatedly calls the click loop function as long as the mouse button is held down and retains control until the button is released. The behavior of `TEClick` depends on whether the Shift key was down at the time of the mouse-down event and on other user actions as follows:

<i>User's Action</i>	<i>Behavior of <code>TEClick</code></i>
Shift key down.	Extend the current selection range.
Shift key not down.	Remove highlighting from current selection range. Position the insertion point as close as possible to the location of the mouse click.
Mouse dragged.	Expand or shorten the selection range a character at a time. Keep control until the user releases the mouse button.
Double-click.	Extend the selection to include the entire word where the cursor is positioned.

## Key-Down Events—Accepting Text Input

On receipt of a key-down event that should be handled by `TextEdit`, your application must call `TEKey` to accept the keyboard input. `TEKey` replaces the current selection range with the character passed to it and moves the insertion point just past the inserted character.

Depending on the requirements of your application, you may need to filter out certain character codes (for example, that for a Tab key press) so that they are not passed to `TEKey`. You should also check that the `TextEdit` limit of 32,767 bytes will not be exceeded by the insertion of the character before calling `TEKey` and you should call your scroll bar adjustment function immediately after the insertion.

## Caret Blinking

To force the insertion point caret to blink, your application must call `TEIdle` at an interval equal to the value stored in the low-memory global `CaretTime`. You can retrieve this value by calling `GetCaretTime`. In Classic event model applications, you should set the `sleep` parameter in the `WaitNextEvent` call to this value and call `TEIdle` when `WaitNextEvent` returns 0 with a null event. In Carbon event model applications, you should install a timer set to fire at this interval and call `TEIdle` when the timer fires.

If there is more than one `TextEdit` structure associated with an active window, you must ensure that you pass `TEIdle` the handle to the currently active `TextEdit` structure. You should also check that the handle to be passed to `TEIdle` does not contain `NULL` before calling the function.

## Cutting, Copying, and Pasting

You can use `TextEdit` to cut, copy, and paste text within and between `TextEdit` structures, and across applications. The relevant functions, and their effect in the case of a monostyled `TextEdit` structure, are as follows:



<i>Function</i>	<i>Use To</i>	<i>Comments</i>
TECut	Cut text.	Copies the text to the TextEdit private scrap.
TECopy	Copy text.	Copies the text to the TextEdit private scrap.
TEPaste	Paste text.	Pastes from the TextEdit private scrap to the TextEdit structure.
TEToScrap	Copy TextEdit private scrap to the Carbon Scrap Manager's scrap.	Copying via the Carbon Scrap Manager's scrap is required if monostyled text is to be carried across applications.
TEFromScrap	Copy the Carbon Scrap Manager's scrap to TextEdit private scrap.	Copying via the Carbon Scrap Manager's scrap is required if text is to be carried across applications.
TEGetScrapLength	Determine the length of the text to be pasted.	Returns the size, in bytes, of the text in the private scrap.

You will need to call your vertical scroll bar adjustment function immediately after cut and paste operations. In addition, you will need to ensure that a paste will not cause the TextEdit limit of 32,767 bytes to be exceeded.

## Inserting and Deleting Text

The following TextEdit functions are used to insert and delete monostyled text:

<i>Function</i>	<i>Use To</i>	<i>Comments</i>
TEInsert	Insert text into the TextEdit structure immediately before the selection range or insertion point.	Does not affect the selection range.  Redraws the text if necessary.
TEDelete	Remove the selected range of text from the TextEdit structure.	Does not transfer the text to either TextEdit's private scrap or the Carbon Scrap Manager's scrap. Useful for implementing a Clear command. Redraws the remaining text if necessary.

You will need to call your vertical scroll bar adjustment function immediately after insertions and deletions. In addition, you will need to ensure that an insertion will not cause the TextEdit limit of 32,767 bytes to be exceeded.



## Setting the Selection Range or Insertion Point

Using the `TESetSelect` function, your application can set the selection range or set the location of the insertion point. (For example, your application might use `TESetSelect` to locate the caret at the start of a data entry field where you want the user to enter a value.) `TESetSelect` changes the value in the `selStart` and `selEnd` fields of the `TextEdit` structure.

To set a selection range, you pass the byte offsets of the starting and ending characters in the `selStart` and `selEnd` parameters. To set the location of the insertion point, you pass the same values in the `selStart` and `selEnd` parameters. You can set the selection range (or insertion point) to any character position corresponding to byte offsets 0 to 32767.

To implement a Select All menu command, pass 0 in the `selStart` parameter and the value in the `teLength` field of the `TextEdit` structure in the `selEnd` parameter.

## Enabling and Disabling

You can use the `TEAutoView` function to enable automatic scrolling (which, by default, is disabled). `TEAutoView` may also be used to disable automatic scrolling.

## Customizing

As previously stated, the default click loop (callback) function does not adjust the scroll bars as the text is scrolled, a situation that can be overcome by replacing the default click loop function with an application-defined click loop (callback) function which updates the scroll bars as it scrolls the text.

The `clickLoop` field of the `TextEdit` structure contains a universal procedure pointer to a click loop (callback) function, which is called continuously as long as the mouse button is held down. Installing your custom function involves a call to `TESetClickLoop` to assign the universal procedure pointer to the `TextEdit` structure's `clickLoop` field.

## Scrolling Text

When a mouse-down event occurs in a scroll bar, your application must determine how far to scroll the text. The basic value for vertical scrolling of monostyled text is typically the value in the `lineHeight` field of the `TextEdit` structure, which can be used as the number of pixels to scroll for clicks in the Up and Down scroll arrows. For clicks in the gray areas/track, this value is typically multiplied by the number of text lines in the view rectangle minus 1. Scrolling by dragging the scroll box/scroller involves determining the number of text lines to scroll based on the current position of the top of the destination rectangle and the control value on mouse button release.

You pass the number of pixels to scroll in a call to `TEScroll` or `TEPinScroll`. (The difference between these two functions is that the latter stops scrolling when the last line is scrolled into the view rectangle.) The destination rectangle is offset by the amount you scroll.

## Forcing the Selection Range into the View

Your application can call `TESeIView` to force the selection range to be displayed in the view rectangle. When automatic scrolling is enabled, `TESeIView` scrolls the selection range into view, if necessary.

## Setting Text Alignment

You can change the alignment of the entire text of a `TextEdit` structure by calling `TESetAlignment`. The following constants apply:

<i>Constant</i>	<i>Description</i>
<code>teFlushDefault</code>	Default alignment according to primary line direction of the script system. (Left for Roman script system.)
<code>teCenter</code>	Center alignment.
<code>teFlushRight</code>	Right alignment.
<code>teFlushLeft</code>	Left alignment.

You should call the Window manager's `InvalWindowRect` function after you change the alignment so that the text is redrawn in the new alignment.

## Saving and Opening TextEdit Documents

The demonstration program in Chapter 18 demonstrates opening and saving monostyled `TextEdit` documents.

## Multistyled TextEdit

With the introduction in Mac OS 9 of the Multilingual Text Editor (see Chapter 26), it became all but inconceivable that programmers would ever again use multistyled `TextEdit` to provide their applications with multistyled text editing capabilities. That said, multistyled `TextEdit` may still be considered useful where the requirement is simply the display of noneditable multistyled text, as in the Help dialog component of the demonstration program associated with this chapter.

This section addresses additional factors and considerations applying to multistyled `TextEdit`, but only to the extent necessary to support an understanding of those factors involved in the display of noneditable styled text, as in the Help dialog component of the demonstration program associated with this chapter.

## Text With Multiple Styles—Style Runs, Text Segments, Font Runs, Character Attributes

Text that uses a variety of fonts, styles, sizes, and colors is referred to as **multistyled text**.

TextEdit organizes multistyled text into **style runs**, which comprise a set of contiguous characters that all share the same font, size, style, and color characteristics. TextEdit tracks style runs in the data structures allocated for a multistyled TextEdit structure and uses this information to correctly display multistyled text.

The part of a style run that exists on a single line is called a **text segment**. A larger division than a style run is the **font run**, which comprises those characters which share the same font. The font, style, size, and color aspects of text are collectively referred to as **character attributes**.

## Additional TextEdit Data Structures for Multistyled Text

The TextEdit structure and the dispatch structure are the only data structures associated with monostyled text. However, when you allocate a multistyled TextEdit structure, a number of additional subsidiary data structures are created to support the text styling capabilities. The first of these additional data structures is the **style structure**, which stores the character attribute information for the text. (Recall that, when a multistyled TextEdit structure is created, the bytes at the `txFont`, `txFace`, and `filler` fields of the TextEdit structure contain a handle to the style structure.)

The additional data structures associated with a multistyled TextEdit structure are shown in Fig 6.

## Creating a Multistyled TextEdit Structure

The multistyled TextEdit structure is created by calling `TEStyleNew`.

## Inserting Text

The following describes `TEStyleInsert`, which is used to insert multistyled text:

<i>Function</i>	<i>Use To</i>	<i>Comments</i>
<code>TEStyleInsert</code>	Insert multistyled text into the TextEdit structure immediately before the selection range or insertion point.	<p>Does not affect the selection range.</p> <p>Redraws the text if necessary.</p> <p>Applies the specified character attributes to the text. (You should create your own style scrap structure, specifying the style attributes to be inserted and applied to the text. These attributes are copied directly into the style structure's style table.)</p>

```

struct TEstyleRec
{
    short      nRuns;        // No of elements in style run table.
    short      nStyles;      // No of elements in style table.
    STHandle   styleTab;     // Handle to style table.
    LHHandle   lhTab;        // Handle to line-height table.
    long       teRefCon;     // Available for application use.
    NullStHandle nullStyle;  // Handle to null style record.
    StyleRun   runs[8001];   // Offsets and style table indices.
};
typedef struct TEstyleRec TEstyleRec;

```

**STYLE STRUCTURE**

The style table contains one entry for each distinct set of character attributes.

```

struct STElement
{
    short      stCount;      // Number of runs in this style.
    short      stHeight;     // Line height this style (points).
    short      stAscent;     // Ascent above baseline this font.
    short      stFont;       // Font (family) number.
    StyleField stFace;       // Character style.
    short      stSize;       // Font size (points).
    RGBColor   stColor;     // Colour used in this style.
};
typedef struct STElement STElement;

```

**STYLE TABLE ELEMENT**

The line-height table contains one entry for each line of text.

```

struct LHElement
{
    short lhHeight; // Maximum height in line.
    short lhAscent; // Maximum ascent in line.
};
typedef struct LHElement LHElement;

```

**LINE-HEIGHT TABLE ELEMENT**

The style run table contains an entry for each style run.

```

struct StyleRun
{
    short startChar; // Starting character position.
    short styleIndex; // Index into style table.
};
typedef struct StyleRun StyleRun;

```

**STYLE RUN TABLE ELEMENT**

```

struct NullStRec
{
    long      teReserved; // Reserved.
    StScrpHandle nullScrap; // Handle to scrap style table.
};
typedef struct NullStRec NullStRec;

```

**NULL STYLE STRUCTURE**

```

struct StScrpRec
{
    short      scrpNStyles; // No of styles in scrap.
    ScrpSTTable scrpStyleTab; // Table of styles for scrap.
};
typedef struct StScrpRec StScrpRec;

```

**STYLE SCRAP STRUCTURE**

The scrap style table contains one entry for each style run in the style scrap structure. It contains information similar to that contained in the style table.

```

struct ScrpSTElement
{
    long      scrpStartChar; // Offset in data.
    short      scrpHeight;   // Line height this style.
    short      scrpAscent;   // Ascent above baseline this font.
    short      scrpFont;     // Font family number.
    StyleField scrpFace;     // Font style
    short      scrpSize;     // Font size (points).
    RGBColor   scrpColor;    // Colour used in this style.
};
typedef struct ScrpSTElement ScrpSTElement;

```

**SCRAP STYLE TABLE ELEMENT**

FIG 6 - THE STYLE STRUCTURE AND SUBSIDIARY DATA STRUCTURES

## Formatting and Displaying Dates, Times, and Numbers

### Preamble—The Text Utilities and International Resources

#### The Text Utilities

The **Text Utilities** are a collection of text-handling functions which you can use to, amongst other things, format numbers, currency, dates, and times.

#### International Resources

Many Text Utilities functions utilize the **international resources**, which define how different text elements are represented depending on the script system in use. The international resources relevant to formatting numbers, currency, dates, and times are as follows:

- **Numeric Format Resource.** The numeric format ('it10') resource contains short date and time formats, and formats for currency and numbers. It provides separators for decimals, thousands, and lists. It also contains the region code for this particular resource. Three of the several variations in short date and time formats are as follows:

<i>System Software</i>	<i>Morning</i>	<i>Afternoon</i>	<i>Short Date</i>
United States	1:02 AM	1:02 PM	2/1/90
Sweden	01:02	13:02	90-01-01
Germany	1:02 Uhr	13:02 Uhr	2.1.1990

- **Long Date Format Resource.** The long date format ('it11') resource specifies the long and abbreviated date formats for a particular region, including the names of days and months and the exact order of presentation of the elements. It also contains a region code for this particular resource. Three of the several variations of the long and abbreviated date formats are as follows:

<i>System Software</i>	<i>Abbreviated Date</i>	<i>Long Date</i>
United States	Tue, Jan 2, 1990	Tuesday, January 2 1990
French	Mar 2 Jan 1990	Mardi 2 Janvier 1990
Australian	Tue, 2 Jan 1990	Tuesday, 2 January 1990

- **Tokens Resource.** The tokens ('it14') resource contains, amongst other things, a table for formatting numbers. This table, which is called the **number parts table**, contains standard representations for the components of numbers and numeric strings. As will be seen, certain Text Utilities number formatting functions use the number parts table to create number strings in localized formats.

# Date and Time

The Text Utilities functions that work with dates and times use information in the international resources to create different representations of date and time values. The Operating System provides functions that return the current date and time in numeric format. Text Utilities functions can then be used to convert these values into strings which can, in turn, be presented in the different international formats.

## Date and Time Value Representations

The Operating System provides the following differing representations of date and time values:

Representation	Description
Standard date-time value.	A 32-bit integer representing the number of seconds between midnight, 1 January 1904 and the current time.
Long date-time value.	A 64-bit signed representation of data type <code>LongDateTime</code> . Allows for coverage of a longer time span than the standard date-time value, specifically, about 30,000 years.
Date-time structure.	Data type <code>DateTimeRec</code> . Includes integer fields for year, month, day, hour, minute, second, and day of week.
Long date-time structure.	Data type <code>LongDateRec</code> . Similar to the date-time structure, except that it adds several additional fields, including integer values for the era, day of the year, and week of the year. Allows for a longer time span than the date-time structure.

The date-time (`DateTimeRec`) and the long date-time (`LongDateRec`) structures are as follows:

```

union LongDateRec
{
    struct
    {
        short era;
        short year;
        short month;
        short day;
        short hour;
        short minute;
        short second;
        short dayOfWeek;
        short dayOfYear;
        short weekOfYear;
        short pm;
        short res1;
        short res2;
        short res3;
    } ld;
};

struct DateTimeRec
{
    short year;
    short month;
    short day;
    short hour;
    short minute;
    short second;
    short dayOfWeek;
};

typedef struct DateTimeRec DateTimeRec;
```

```

short list[14];
struct
{
    short        eraAlt;
    DateTimeRec  oldDate;
} od;
};

typedef union LongDateRec LongDateRec;

```

## Obtaining Date-Time Values and Structures

The Operating System Utilities provide the following two functions for obtaining date-time values and structures.

<i>Function</i>	<i>Description</i>
GetDateTime	Returns a standard date-time value.
GetTime	Returns a date-time structure.

## Converting Between Values and Structures

The Operating System provides the following four functions for converting between the different date and time data types:

<i>Function</i>	<i>Converts</i>	<i>To</i>
DateToSeconds	Date-time structure.	Standard date-time value.
SecondsToDate	Standard date-time value.	Date-time structure.
LongDateToSeconds	Long date-time structure.	Long date-time value.
LongSecondsToDate	Long date-time value.	Long date-time structure.

## Converting Date-Time Values into Strings

The Text Utilities provide the following functions for converting from one of the numeric date-time representations to a formatted string.

<i>Function</i>	<i>Description</i>
DateString	Converts standard date-time value to a date string formatted according to the specified international resource.
LongDateString	Converts long date-time value to a date string formatted according to the specified international resource.
TimeString	Converts standard date-time value to a time string formatted according to the specified international resource.
LongTimeString	Converts long date-time values to a time string formatted according to the specified international resource.



**Output Format—Date.** When you use `DateString` and `LongDateString`, you can specify, in the `longFlag` parameter, an output format for the resulting date string. This format can be one of the following three values of the `DateForm` enumerated data type:

<i>Value</i>	<i>Date String Produced (Example)</i>	<i>Formatting Information Obtained From</i>
<code>shortDate</code>	1/31/92	Numeric format resource ('it10').
<code>abbrevDate</code>	Fri, Jan 31, 1992	Long date format resource ('it11').
<code>longDate</code>	Friday, January 31, 1992	Long date format resource ('it11').

**Output Format—Time.** When you use `TimeString` and `LongTimeString`, you can request an output format for the resulting time string by specifying either `true` or `false` in the `wantSeconds` parameter. `true` will cause seconds to be included in the string.

`DateString`, `LongDateString`, `TimeString` and `LongTimeString` use the date and time formatting information in the format resource that you specify in the resource handle (`intlHandle`) parameter. If you specify `NULL` for the value of the resource handle parameter, the appropriate format resource for the current script system is used.

## Converting Date-Time Strings into Internal Numeric Representation

The Text Utilities include functions that can parse date and time strings as entered by users and fill in the fields of a structure with the components of the date and time, including the month, day, year, hours, minutes, and seconds, extracted from the string.

Suppose your application needs to convert a date and time string typed in by the user (for example, “March 27, 1992, 08:14 p.m.”) into numeric representation. The following Text Utilities functions can be used to convert the string entered by the user into a long date-time structure:

<i>Function</i>	<i>Description</i>
<code>StringToDate</code>	<p>Parses an input string for a date and creates an internal numeric representation of that date. Returns a status value indicating the confidence level for the success of the conversion.</p> <p>Expects a date specification, in one of the formats defined by the current script system, at the beginning of the string. Recognizes date strings in many formats, for example: “September 1, 1987”, “1 Sept 87”, “1/9/87”, and “1 1987 Sept”.</p>
<code>StringToTime</code>	<p>Parses an input string for a time and creates an internal numeric representation of that time. Returns a status value indicating the confidence level for the success of the conversion.</p> <p>Expects a time specification, in a format defined by the current script system, at the beginning of the string.</p>



You usually call `StringToDate` and `StringToTime` sequentially to parse the date and time values from an input string and fill in the fields of a long date-time structure. Note that `StringToDate` assigns to its `lengthUsed` parameter the number of bytes that it uses to parse the date. Use this value to compute the starting location of the text that you can pass to `StringToTime`.

The “confidence level” value returned by both `StringToDate` and `StringToTime` is of type `StringToDateStatus`, a set of bit values which have been OR’d together. The higher the resultant number, the lower the confidence level. Three of the twelve `StringToDateStatus` values, and their meanings, are as follows:

<i>Value</i>	<i>Meaning</i>
<code>fataldateTime</code>	Fatal error during the parse.
<code>dateTimeNotFound</code>	Valid date or time value not be found in string.
<code>sepNotIntlSep</code>	Valid date or time value found, but one or more of the separator characters in the string was not an expected separator character for the script system in use.

**Date Cache Structure.** Both `StringToDate` and `StringToTime` take a **date cache structure** as one of their parameters. A date cache structure (a data structure of type `DateCacheRec`) stores date conversion data used by the date and time conversion functions. You must declare a data cache structure in your application and initialize it by calling `InitDateCache` once, typically in your main program initialization code.

## Numbers

The Text Utilities provide several functions for converting between the internal numeric representation of a number and the output (or input) format of that number. You will need to perform these conversions when the user enters numbers for your application to use or when you present numbers to the user.

## Integers

The simplest number conversion tasks involve integer values. The following Text Utilities functions may be used to convert an integer value to a numeric string and vice versa:

<i>Function</i>	<i>Description</i>
<code>NumToString</code>	Converts a long integer value into a string representation.
<code>StringToNum</code>	Converts a string representation of a number into a long integer value.

The range of values accommodated by these functions is -2,147,483,647 to 2,147,483,648. No comma insertion or other formatting is performed.

## Number Format Specification Strings

**Number format specification strings** define the appearance of numeric strings. When you need to accommodate the differences in number output formats for different countries and regions, or when you are working with floating point numbers, you will need to use number format specification strings.

**Parts.** Each number format specification string contains up to three parts:

- The positive number format.
- The negative number format.
- The zero number format.

Each of these formats is applied to a numeric value of the corresponding type. When the specification string contains only one part, that part is used for all values. When it contains two parts, the first part is used for positive and zero values and the second part is used for negative values.

**Elements.** A number format specification string can contain the following elements:

- Number parts separators (, and .) for the decimal separator and the thousands separator.
- Literals to be included in the output. (Literals can be strings or brackets, braces and parentheses, and must be enclosed in quotation marks.)
- Digit place holders. (Digit place holders that you want displayed must be indicated by digit symbols. Zero digits (0) add leading zeroes whenever an input digit is not present. Skipping digits (#) only produce output characters when an input digit is present. Padding digits (^) are like zero digits except that a padding character such as a non-breaking space is used instead of leading zeros to pad the output string.)
- Quoting mechanisms for handling literals correctly.
- Symbol and sign characters.

**Examples.** The following shows several different number format specification strings and the output produced by each:

<i>Number Format Specification String</i>	<i>Numeric Value</i>	<i>Output Format</i>
###,###.##;-###,###.##;0	876543.21	876,543.21
###,###.0##,###	4321	4,321.0
###,###.0##,###	7.563489	7.563,489
###;(000);^^^	-1	(001)
###.###	5.234999	5.235
###'CR';###'DB';''zero''	1	1CR
###'CR';###'DB';''zero''	0	'zero'
##%	0.1	10%

Integer digits are always filled in from the right and decimal places are always filled in from the left. The following examples, in which a literal is included in the middle of the format strings, demonstrate this behavior:

<i>Number Format Specification String</i>	<i>Numeric Value</i>	<i>Output Format</i>
###'ab'###	1	1
###'ab'###	123	123
###'ab'###	1234	1ab1234
0.###'ab'###	0.1	0.1
0.###'ab'###	0.123	1.123
0.###'ab'###	0.1234	0.123ab4

**Overflow and Rounding.** If the input string contains more digits than are specified in the number format specification string, an error (`formatOverflow`) will be generated. If the input string contains more decimal places than are specified in the number format specification string, the decimal portion is automatically rounded.

**Converting Number Format Specification Strings to Internal Numeric Representations.** With the required number format specification string defined, you must then convert the string into an internal numeric representation. The internal representation of format strings is stored in a `NumFormatString` structure. You use the following functions to convert a number format specification string to a `NumFormatString` structure and vice versa.

<i>Function</i>	<i>Description</i>
StringToFormatRec	Converts a number format specification string into a NumFormatString structure.
FormatRecToString	Convert a NumFormatString structure back to a number format specification string.

**Number Parts Table.** The internal numeric representation allows you to map the number into different output formats. One of the parameters taken by StringToFormatRec is a number parts table. The number parts table specifies which characters are used for certain purposes, such as separating parts of a number, in the format specification string. (For example, a thousands separator is a comma in Australia and a decimal point in France.) As previously stated, the number parts table is contained in the 'itl4' resource. A handle to the 'itl4' resource may be obtained by a call to GetIntlResourceTable, specifying `iuNumberPartsTable` in the `tableCode` parameter.

#### NOTE

The FormatRecToString function also contains a number parts table parameter. By using a different table than was used in the call to StringToFormatRec, you can produce a number format specification string that specifies how numbers are formatted for a different region of the world. You use FormatRecToString when you want to display the number format specification string to the user for perusal or modification.

## Converting Between Floating Point Numbers and Numeric Strings

Armed with a NumFormatString structure, you can convert floating point numbers into numeric strings and numeric strings into floating point numbers using the following functions:

<i>Function</i>	<i>Description</i>
StringToExtended	Using a NumFormatString structure and a number parts table, converts a numeric string to an 80-bit floating point value.
ExtendedToString	Using a NumFormatString structure and a number parts table, converts an 80-bit floating point number to a numeric string.

**PowerPC Considerations.** The PowerPC-based Macintosh follows the IEEE 754 standard for floating point arithmetic. In this standard, `float` is 32 bits and `double` is 64 bits. (Apple has added the 128-bit long `double` type.) However, the PowerPC floating point unit does not

support Motorola's 80/96-bit extended type, and neither do the PowerPC numerics. To accommodate this, you can use Apple-supplied conversion utilities to move to and from extended. For example, the functions `x80tod` and `dtox80` (see the header file `fp.h`) can be used to directly transform 680x0 80-bit extended data types to double and back.

`StringToFormatRec`, `FormatRecToString`, `StringToExtended`, and `ExtendedToString` return a result of type `FormatStatus`, which is an integer value. The low byte is of type `FormatResultType`. Typical examples of the returned format status are as follows:

<i>Value</i>	<i>Meaning</i>
<code>fFormatOK</code>	The format of the input value is appropriate and the conversion was successful.
<code>fBestGuess</code>	The format of the input value is questionable. The result of the conversion may or may not be correct.
<code>fBadPartsTable</code>	The parts table is not valid.

## Main TextEdit Constants, Data Types and Functions

### Constants

#### Alignment

```
teFlushDefault    = 0
teCenter          = 1
teFlushRight      = -1
teFlushLeft       = -2
```

#### Feature or Bit Definitions for `TEFeatureFlag` Feature Parameter

```
teFAutoScroll      = 0
teFTextBuffering   = 1
teFOutlineHilite   = 2
teFInlineInput     = 3
teFUseWhiteBackground = 4
teFUseInlineInput  = 5
teFInlineInputAutoScroll = 6
```

### Data Types

```
typedef char    Chars[32001];
typedef char    *CharsPtr;
typedef CharsPtr *CharsHandle;
```

#### TextEdit Structure

```
struct TERec
{
    Rect    destRect;    // Destination rectangle.
    Rect    viewRect;    // View rectangle.
    Rect    selRect;     // Selection rectangle.
```

```

short      lineHeight;    // Vert spacing of lines. -1 in multistyled edit struct.
short      fontAscent;    // Font ascent. -1 in multistyled TextEdit structure.
Point      selPoint;      // Point selected with the mouse.
short      selStart;      // Start of selection range.
short      selEnd;        // End of selection range.
short      active;        // Set when structure is activated or deactivated.
WordBreakUPP wordBreak;   // Word break function.
TEClickLoopUPP clickLoop; // Click loop function.
long       clickTime;     // (Used internally.)
short      clickLoc;      // (Used internally.)
long       caretTime;     // (Used internally.)
short      caretState;    // (Used internally.)
short      just;          // Text alignment.
short      teLength;      // Length of text.
Handle     hText;         // Handle to text to be edited.
long       hDispatchRec;  // Handle to TextEdit dispatch structure.
short      clicStuff;     // (Used internally)
short      crOnly;        // If < 0, new line at Return only.
short      txFont;        // Text font. // If multistyled edit struct (txSize = -1),
StyleField txFace;        // Chara style. // these bytes are used as a handle
SInt8      filler;        // to a style structure (TStyleHandle).
short      txMode;        // Pen mode.
short      txSize;        // Font size. -1 in multistyled TextEdit structure.
GrafPtr    inPort;       // Pointer to grafPort for this TextEdit structure.
HighHookUPP highHook;    // Used for text highlighting, caret appearance.
CaretHookUPP caretHook;  // Used from assembly language.
short      nLines;        // Number of lines.
short      lineStarts[16001]; // Positions of line starts.
};
typedef struct TERec TERec;
typedef TERec *TEPtr;
typedef TEPtr *TEHandle;

```

## Style Structure

```

struct TStyleRec
{
    short      nRuns;       // Number of style runs.
    short      nStyles;     // Size of style table.
    STHandle   styleTab;    // Handle to style table.
    LHHandle   lhTab;       // Handle to line-height table.
    long       teRefCon;    // Reserved for application use.
    NullStHandle nullStyle; // Handle to style set at null selection.
    StyleRun   runs[8001];  // ARRAY [0..8000] OF StyleRun.
};
typedef struct TStyleRec TStyleRec;
typedef TStyleRec *TStylePtr;
typedef TStylePtr *TStyleHandle;

```

## Text Style Structure

```

struct TextStyle
{
    short      tsFont;      // Font (family) number.
    StyleField tsFace;      // Character Style.
    short      tsSize;      // Size in point.
    RGBColor   tsColor;     // Absolute (RGB) color.
};

```

```
typedef struct TextStyle TextStyle;
typedef TextStyle *TextStylePtr;
typedef TextStylePtr *TextStyleHandle;
```

## Functions

### Creating and Disposing of TextEdit Structures

```
TEHandle  TENew(const Rect *destRect,const Rect *viewRect);
TEHandle  TStyleNew(const Rect *destRect,const Rect *viewRect);
void      TEDispose(TEHandle hTE);
```

### Activating and Deactivating a TextEdit Structure

```
void      TEActivate(TEHandle hTE);
void      TEDeactivate(TEHandle hTE);
```

### Setting and Getting a TextEdit Structure's Text

```
void      TEKey(short key,TEHandle hTE);
void      TEText(const void *text,long length,TEHandle hTE);
CharsHandle TEGetText(TEHandle hTE);
```

### Setting the Caret and Selection Range

```
void      TEIdle(TEHandle hTE);
void      TEClick(Point pt,Boolean fExtend,TEHandle h);
void      TETextSelect(long selStart,long selEnd,TEHandle hTE);
```

### Displaying and Scrolling Text

```
void      TETextAlign(short just,TEHandle hTE);
void      TEUpdate(const Rect *rUpdate,TEHandle hTE);
void      TETextBox(const void *text,long length,const Rect *box,short just);
void      TETextCalc(TEHandle hTE);
long      TETextHeight(long endLine,long startLine,TEHandle hTE);
void      TETextScroll(short dh,short dv,TEHandle hTE);
void      TETextPinScroll(short dh,short dv,TEHandle hTE);
void      TETextAutoView(Boolean fAuto,TEHandle hTE);
void      TETextSelView(TEHandle hTE);
```

### Modifying the Text of a TextEdit Structure

```
void      TETextDelete(TEHandle hTE);
void      TETextInsert(const void *text,long length,TEHandle hTE);
void      TETextStyleInsert(const void *text,long length,StScrpHandle hST,TEHandle hTE);
void      TETextCut(TEHandle hTE);
void      TETextCopy(TEHandle hTE);
void      TETextPaste(TEHandle hTE);
OSErr     TETextFromScrap(void);
OSErr     TETextToScrap(void);
```

### Managing the TextEdit Private Scrap

```
Handle     TETextScrapHandle(void);
long       TETextGetScrapLength(void);
void       TETextSetScrapLength(long length);
```

### Using Byte Offsets and Corresponding Points

```
short      TETextGetOffset(Point pt,TEHandle hTE);
Point      TETextGetPoint(short offset,TEHandle hTE);
```

## Customising TextEdit

```
void      TSEtClickLoop(TEClickLoopUPP clickProc,TEHandle hTE);;
void      TSEtWordBreak(WordBreakUPP wBrkProc,TEHandle hTE);;
void      TECustomHook(TEIntHook which, UniversalProcPtr *addr,TEHandle hTE);;
```

## Additional TextEdit Features

```
short      TEFeatureFlag(short feature,short action,TEHandle hTE);
```

# Main Constants, Data Types and Functions Relating to Dates, Times and Numbers

## Constants

### StringToDate and StringToTime Status Values

```
fatalDateTime      = 0x8000  Mask to a fatal error.
longDateFound      = 1       Mask to long date found.
leftOverChars      = 2       Mask to warn of left over characters.
sepNotInt1Sep      = 4       Mask to warn of non-standard separators.
fieldOrderNotInt1  = 8       Mask to warn of non-standard field order.
extraneousStrings  = 16      Mask to warn of unparsable strings in text.
tooManySepts      = 32      Mask to warn of too many separators.
sepNotConsistent   = 64      Mask to warn of inconsistent separators.
tokenErr           = 0x8100  Mask for 'tokenizer err encountered'.
cantReadUtilities   = 0x8200
dateTimeNotFound    = 0x8400
dateTimeInvalid     = 0x8800
```

### FormatResultType Values for Numeric Conversion Functions

```
fFormatOK          = 0
fBestGuess         = 1
fOutOfSynch        = 2
fSpuriousChars     = 3
fMissingDelimiter  = 4
fExtraDecimal      = 5
fMissingLiteral    = 6
fExtraExp          = 7
fFormatOverflow    = 8
fFormStrIsNAN      = 9
fBadPartsTable     = 10
fExtraPercent      = 11
fExtraSeparator    = 12
fEmptyFormatString = 13
```

## Data Types

```
typedef short  StringToDateStatus;
typedef Sint8  DateForm;
typedef short  FormatStatus;
typedef Sint8  FormatResultType;
```



### Data Cache Structure

```
struct DateCacheRecord
{
    short    hidden[256]; // Only for temporary use.
};
typedef struct DateCacheRecord DateCacheRecord;
typedef DateCacheRecord *DateCachePtr;
```

### Number Format Specification Structure

```
struct NumFormatString
{
    UInt8 fLength;
    UInt8 fVersion;
    char  data[254]; // Private data.
};
typedef struct NumFormatString NumFormatString;
typedef NumFormatString NumFormatStringRec;
```

## Functions

### Getting Date-Time Values and Structures

```
void    GetDateTime(unsigned long *secs);
void    GetTime(DateTimeRec *d);
```

### Converting Between Date-Time Values and Structures

```
void    DateToSeconds(const DateTimeRec *d,unsigned long *secs);
void    SecondsToDate(unsigned long secs,DateTimeRec *d);
void    LongDateToSeconds(const LongDateRec *lDate,LongDateTime *lSecs);
void    LongSecondsToDate(LongDateTime *lSecs,LongDateRec *lDate);
```

### Converting Date-Time Strings into Internal Numeric Representation

```
OSErr    InitDateCache(DateCachePtr theCache);
StringToDateStatus    StringToDate(Ptr textPtr,long textLen,DateCachePtr theCache,
                                   long *lengthUsed,LongDateRec *dateTime);
StringToDateStatus    StringToTime(Ptr textPtr,long textLen,DateCachePtr theCache,
                                   long *lengthUsed,LongDateRec *dateTime);
```

### Converting Long Date and Time Values into Strings

```
void    DateString(long dateTime,DateForm longFlag,Str255 result);
void    TimeString(long dateTime,Boolean wantSeconds,Str255 result);
void    LongDateString(LongDateTime *dateTime,DateForm longFlag,Str255 result,
                      Handle intlHandle);
void    LongTimeString(LongDateTime *dateTime,Boolean wantSeconds,Str255 result,
                      Handle intlHandle);
```

### Converting Between Integers and Strings

```
void    StringToNum(ConstStr255Param theString,long *theNum);
void    NumToString(long theNum,Str255 theString);
```

## Using Number Format Specification Strings for International Number Formatting

```
FormatStatus StringToFormatRec(ConstStr255Param inString,const NumberParts *partsTable,
                               NumFormatString *outString)
FormatStatus FormatRecToString(const NumFormatString *myCanonical,
                               const NumberParts *partsTable,Str255 outString,TripleInt positions)
```

## Converting Between Strings and Floating Point Numbers

```
FormatStatus ExtendedToString(const extended80 x,const NumFormatString *myCanonical,
                               const NumberParts *partsTable,Str255 outString)
FormatStatus StringToExtended(ConstStr255Param source,const NumFormatString *myCanonical,
                               const NumberParts *partsTable,extended80 *x)
```

## Moving to and from Extended

```
void x80told(const extended80 *x80,long double *x);
void ldtox80(const long double *x,extended80 *x80);
double x80tod(const extended80 *x80);
void dtox80(const double *x, extended80 *x80);
```

## Demonstration Program MonoTextEdit Listing

```
// *****
// MonoTextEdit.c CARBON EVENT MODEL
// *****
//
// This program demonstrates:
//
// · A "bare-bones" monostyled text editor.
//
// · A Help dialog which features the integrated scrolling of multistyled text and pictures.
//
// In the monostyled text editor demonstration, a panel is displayed at the bottom of all
// opened windows. This panel displays the edit record length, number of lines, line height,
// destination rectangle (top), scroll bar/scroller value, and scroll bar/scroller maximum
// value.
//
// The bulk of the source code for the Help dialog is contained in the file HelpDialog.c.
// The dialog itself displays information intended to assist the user in adapting the Help
// dialog source code and resources to the requirements of his/her own application.
//
// The program utilises the following resources:
//
// · A 'plst' resource.
//
// · An 'MBAR' resource, and 'MENU' resources for Apple, File, Edit, and Help dialog pop-up
// menus (preload, non-purgeable).
//
// · A 'CNTL' resources (purgeable) for the vertical scroll bar in the text editor window.
//
// · 'TEXT' and associated 'styl' resources (all purgeable) for the Help dialog.
//
// · 'PICT' resources (purgeable) for the Help dialog.
//
// · A 'STR#' resource (purgeable) containing error text strings.
//
```

```

// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****
// ..... includes
#include <Carbon.h>
// ..... defines
#define rMenubar          128
#define mAppleApplication 128
#define iAbout            1
#define iHelp             2
#define mFile             129
#define iNew              1
#define iOpen             2
#define iClose            4
#define iSaveAs           6
#define iQuit             12
#define mEdit             130
#define iUndo             1
#define iCut              3
#define iCopy             4
#define iPaste            5
#define iClear            6
#define iSelectAll        7
#define rVScrollbar       128
#define rErrorStrings     128
#define eMenuBar          1
#define eWindow           2
#define eDocStructure     3
#define eEditRecord       4
#define eExceedChara      5
#define eNoSpaceCut       6
#define eNoSpacePaste     7
#define kMaxTELength      32767
#define kTab              0x09
#define kBackSpace        0x08
#define kForwardDelete    0x7F
#define kReturn           0x0D
#define kEscape           0x1B
#define topLeft(r)        (((Point *) &(r))[0])
#define botRight(r)       (((Point *) &(r))[1])
// ..... typedefs
typedef struct
{
    TEHandle  textEditStrucHdl;
    ControlRef vScrollbarRef;
} docStructure, **docStructureHandle;

```

```
// ..... global variables

Boolean      gRunningOnX = false;
MenuID       gHelpMenu;
ControlActionUPP gScrollActionFunctionUPP;
TEClickLoopUPP gCustomClickLoopUPP;
SInt16       gNumberOfWindows = 0;
SInt16       gOldControlValue;

// ..... function prototypes

void         main                (void);
void         doPreliminaries     (void);
OSStatus     appEventHandler     (EventHandlerCallRef,EventRef,void *);
OSStatus     windowEventHandler  (EventHandlerCallRef,EventRef,void *);
void         doIdle              (void);
void         doKeyEvent          (SInt8);
void         scrollActionFunction (ControlRef,SInt16);
void         doInContent         (Point,Boolean);
void         doDrawContent       (WindowPtr);
void         doActivateDeactivate (WindowRef,Boolean);
WindowRef    doNewDocWindow      (void);
EventHandlerUPP doGetHandlerUPP  (void);
Boolean      customClickLoop     (void);
void         doSetScrollBarValue (ControlRef,SInt16 *);
void         doAdjustMenus       (void);
void         doMenuChoice        (MenuID,MenuItemIndex);
void         doFileMenu          (MenuItemIndex);
void         doEditMenu          (MenuItemIndex);
SInt16       doGetSelectLength   (TEHandle);
void         doAdjustScrollbar   (WindowRef);
void         doAdjustCursor      (WindowRef);
void         doCloseWindow       (WindowRef);
void         doSaveAsFile        (TEHandle);
void         doOpenCommand       (void);
void         doOpenFile          (FSSpec);
void         doDrawDataPanel     (WindowRef);
void         doErrorAlert        (SInt16);
void         navEventFunction    (NavEventCallbackMessage,NavCBRecPtr,
                                NavCallBackUserData);

extern void   doHelp              (void);

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;
    MenuRef        menuRef;
    EventTypeSpec applicationEvents[] = { { kEventClassApplication, kEventAppActivated },
                                           { kEventClassCommand,      kEventProcessCommand },
                                           { kEventClassMenu,          kEventMenuEnableItems },
                                           { kEventClassMouse,         kEventMouseMoved } };
}
```

```

// ..... do preliminaries

doPreliminaries();

// ..... set up menu bar and menus

menubarHdl = GetNewMBar(rMenuBar);
if(menubarHdl == NULL)
    doErrorAlert(eMenuBar);
SetMenuBar(menubarHdl);
DrawMenuBar();

Gestalt(gestaltMenuMgrAttr,&response);
if(response & gestaltMenuMgrAquaLayoutMask)
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
    {
        DeleteMenuItem(menuRef,iQuit);
        DeleteMenuItem(menuRef,iQuit - 1);
    }

    menuRef = GetMenuRef(mAppleApplication);
    DeleteMenuItem(menuRef,iHelp);

    HMGetHelpMenu(&menuRef,NULL);
    InsertMenuItem(menuRef,"pMonoTextEdit Help",0);
    gHelpMenu = GetMenuID(menuRef);

    gRunningOnX = true;
}
else
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
        SetMenuItemCommandID(menuRef,iQuit,kHICommandQuit);
}

// ..... create universal procedure pointers

gScrollActionFunctionUPP = NewControlActionUPP((ControlActionProcPtr) scrollActionFunction);
gCustomClickLoopUPP      = NewTEClickLoopUPP((TEClickLoopProcPtr) customClickLoop);

// ..... install application event handler

InstallApplicationEventHandler(NewEventHandlerUPP((EventHandlerProcPtr) appEventHandler),
                             GetEventTypeCount(applicationEvents),applicationEvents,
                             0,NULL);

// ..... install a timer

InstallEventLoopTimer(GetCurrentEventLoop(),0,TicksToEventTime(GetCaretTime()),
                     NewEventLoopTimerUPP((EventLoopTimerProcPtr) doIdle),NULL,
                     NULL);

```

```

// ..... open an untitled window

doNewDocWindow();

// ..... run application event loop

RunApplicationEventLoop();
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(192);
    InitCursor();
}

// ***** appEventHandler

OSStatus appEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                        void * userData)
{
    OSStatus      result = eventNotHandledErr;
    UInt32        eventClass;
    UInt32        eventKind;
    HICCommand     hiCommand;
    MenuItem       menuItem;
    MenuItemIndex  menuItemIndex;

    eventClass = GetEventClass(eventRef);
    eventKind  = GetEventKind(eventRef);

    switch(eventClass)
    {
        case kEventClassApplication:
            if(eventKind == kEventAppActivated)
                SetThemeCursor(kThemeArrowCursor);
            break;

        case kEventClassCommand:
            if(eventKind == kEventProcessCommand)
            {
                GetEventParameter(eventRef, kEventParamDirectObject, typeHICCommand, NULL,
                                sizeof(HICCommand), NULL, &hiCommand);
                menuItemIndex = GetMenuItem(hiCommand.menu.menuRef);
                menuItem = hiCommand.menu.menuItemIndex;
                if((hiCommand.commandID != kHICCommandQuit) &&
                    ((menuItemIndex >= mAppleApplication && menuItemIndex <= mEdit) || menuItemIndex == gHelpMenu))
                {
                    doMenuChoice(menuItemIndex, menuItem);
                    result = noErr;
                }
            }
            break;
    }
}

```

```

    case kEventClassMenu:
        if(eventKind == kEventMenuEnableItems)
        {
            GetWindowClass(FrontWindow(), &windowClass);
            if(windowClass == kDocumentWindowClass)
                doAdjustMenus();
            result = noErr;
        }
        break;

    case kEventClassMouse:
        if(eventKind == kEventMouseMoved)
        {
            GetWindowClass(FrontWindow(), &windowClass);
            if(windowClass == kDocumentWindowClass)
                doAdjustCursor(FrontWindow());
            result = noErr;
        }
        break;

    return result;
}

// ***** windowEventHandler

OSStatus windowEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                           void* userData)
{
    OSStatus      result = eventNotHandledErr;
    UInt32        eventClass;
    UInt32        eventKind;
    WindowRef     windowRef;
    UInt32        modifiers;
    Point         mouseLocation;
    Boolean        shiftKeyDown = false;
    ControlRef     controlRef;
    ControlPartCode controlPartCode;
    SInt8         charCode;

    eventClass = GetEventClass(eventRef);
    eventKind = GetEventKind(eventRef);

    switch(eventClass)
    {
    case kEventClassWindow: // event class window
        GetEventParameter(eventRef, kEventParamDirectObject, typeWindowRef, NULL, sizeof(WindowRef),
                           NULL, &windowRef);
        switch(eventKind)
        {
        case kEventWindowDrawContent:
            doDrawContent(windowRef);
            result = noErr;
            break;

```

```

case kEventWindowActivated:
    doActivateDeactivate(windowRef,true);
    result = noErr;
    break;

case kEventWindowDeactivated:
    doActivateDeactivate(windowRef,false);
    result = noErr;
    break;

case kEventWindowClickContentRgn:
    GetEventParameter(eventRef,kEventParamMouseLocation,typeQDPoint,NULL,
        sizeof(mouseLocation),NULL,&mouseLocation);
    SetPortWindowPort(FrontWindow());
    GlobalToLocal(&mouseLocation);
    GetEventParameter(eventRef,kEventParamKeyModifiers,typeUInt32,NULL,
        sizeof(modifiers),NULL,&modifiers);
    if(modifiers & shiftKey)
        shiftKeyDown = true;
    doInContent(mouseLocation,shiftKeyDown);
    result = noErr;
    break;

case kEventWindowClose:
    doCloseWindow(windowRef);
    result = noErr;
    break;
}
break;

case kEventClassMouse:                                     // event class mouse
{
    switch(eventKind)
    {
        case kEventMouseDown:
            GetEventParameter(eventRef,kEventParamMouseLocation,typeQDPoint,NULL,
                sizeof(mouseLocation),NULL,&mouseLocation);
            SetPortWindowPort(FrontWindow());
            GlobalToLocal(&mouseLocation);
            controlRef = FindControlUnderMouse(mouseLocation,FrontWindow(),&controlPartCode);
            if(controlRef)
            {
                gOldControlValue = GetControlValue(controlRef);
                TrackControl(controlRef,mouseLocation,gScrollActionFunctionUPP);
                result = noErr;
            }
            break;
    }
}
break;

case kEventClassKeyboard:                                  // event class keyboard
{
    switch(eventKind)
    {
        case kEventRawKeyDown:

```



```

        case kEventRawKeyRepeat:
            GetEventParameter(eventRef, kEventParamKeyMacCharCodes, typeChar, NULL,
                              sizeof(charCode), NULL, &charCode);
            GetEventParameter(eventRef, kEventParamKeyModifiers, typeUInt32, NULL,
                              sizeof(modifiers), NULL, &modifiers);
            if((modifiers & cmdKey) == 0)
                doKeyEvent(charCode);
            result = noErr;
            break;
    }
    break;
}

return result;
}

// ***** doIdle

void doIdle(void)
{
    WindowRef          windowRef;
    docStructureHandle docStrucHdl;

    windowRef = FrontWindow();
    if(GetWindowKind(windowRef) == kApplicationWindowKind)
    {
        docStrucHdl = (docStructureHandle) (GetWRefCon(windowRef));
        if(docStrucHdl != NULL)
            TEIdle((*docStrucHdl)->textEditStrucHdl);
    }
}

// ***** doKeyEvent

void doKeyEvent(SInt8 charCode)
{
    WindowRef          windowRef;
    docStructureHandle docStrucHdl;
    TEHandle           textEditStrucHdl;
    SInt16              selectionLength;

    if(charCode <= kEscape && charCode != kBackSpace && charCode != kReturn)
        return;

    windowRef = FrontWindow();
    docStrucHdl = (docStructureHandle) (GetWRefCon(windowRef));
    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

    if(charCode == kTab)
    {
        // Do tab key handling here if required.
    }
    else if(charCode == kForwardDelete)

```

```

{
    selectionLength = doGetSelectLength(textEditStrucHdl);
    if(selectionLength == 0)
        (*textEditStrucHdl)->selEnd += 1;
    TEDelete(textEditStrucHdl);
    doAdjustScrollbar(windowRef);
}
else
{
    selectionLength = doGetSelectLength(textEditStrucHdl);
    if(((textEditStrucHdl)->teLength - selectionLength + 1) < kMaxTELength)
    {
        TEKey(charCode, textEditStrucHdl);
        doAdjustScrollbar(windowRef);
    }
    else
        doErrorAlert(eExceedChara);
}

doDrawDataPanel(windowRef);
}

// ***** scrollActionFunction

void scrollActionFunction(ControlRef controlRef, Sint16 partCode)
{
    WindowRef          windowRef;
    docStructureHandle docStrucHdl;
    TEHandle            textEditStrucHdl;
    Sint16              linesToScroll;
    Sint16              controlValue, controlMax;

    windowRef = GetControlOwner(controlRef);
    docStrucHdl = (docStructureHandle) (GetWRefCon(windowRef));
    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

    controlValue = GetControlValue(controlRef);
    controlMax = GetControlMaximum(controlRef);

    if(partCode)
    {
        if(partCode != kControlIndicatorPart)
        {
            switch(partCode)
            {
                case kControlUpButtonPart:
                case kControlDownButtonPart:
                    linesToScroll = 1;
                    break;

                case kControlPageUpPart:

```

```

        case kControlPageDownPart:
            linesToScroll = (((*textEditStrucHdl)->viewRect.bottom -
                               (*textEditStrucHdl)->viewRect.top) /
                               (*textEditStrucHdl)->lineHeight) - 1;

            break;
    }

    if((partCode == kControlDownButtonPart) || (partCode == kControlPageDownPart))
        linesToScroll = -linesToScroll;

    linesToScroll = controlValue - linesToScroll;
    if(linesToScroll < 0)
        linesToScroll = 0;
    else if(linesToScroll > controlMax)
        linesToScroll = controlMax;

    SetControlValue(controlRef, linesToScroll);

    linesToScroll = controlValue - linesToScroll;
}
else
{
    linesToScroll = gOldControlValue - controlValue;
    gOldControlValue = controlValue;
}

if(linesToScroll != 0)
{
    TEScroll(0, linesToScroll * (*textEditStrucHdl)->lineHeight, textEditStrucHdl);
    doDrawDataPanel(windowRef);
}
}
}

// ***** doInContent

void doInContent(Point mouseLocation, Boolean shiftKeyDown)
{
    WindowRef          windowRef;
    docStructureHandle docStrucHdl;
    TEHandle            textEditStrucHdl;

    windowRef = FrontWindow();
    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

    if(PtInRect(mouseLocation, &(*textEditStrucHdl)->viewRect))
        TEClick(mouseLocation, shiftKeyDown, textEditStrucHdl);
}

```

```
// ***** doDrawContent

void doDrawContent(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    TEHandle           textEditStrucHdl;
    GrafPtr            oldPort;
    RgnHandle           visibleRegionHdl = NewRgn();
    Rect               portRect;

    docStrucHdl = (docStructureHandle) (GetWRefCon(windowRef));
    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    GetPortVisibleRegion(GetWindowPort(windowRef), visibleRegionHdl);
    EraseRgn(visibleRegionHdl);

    UpdateControls(windowRef, visibleRegionHdl);

    GetWindowPortBounds(windowRef, &portRect);
    TEUpdate(&portRect, textEditStrucHdl);

    doDrawDataPanel(windowRef);

    DisposeRgn(visibleRegionHdl);
    SetPort(oldPort);
}

// ***** doActivateDocWindow

void doActivateDeactivate(WindowRef windowRef, Boolean becomingActive)
{
    docStructureHandle docStrucHdl;
    TEHandle           textEditStrucHdl;

    docStrucHdl = (docStructureHandle) (GetWRefCon(windowRef));
    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

    if(becomingActive)
    {
        SetPortWindowPort(windowRef);

        (*textEditStrucHdl)->viewRect.bottom = (((*textEditStrucHdl)->viewRect.bottom -
            (*textEditStrucHdl)->viewRect.top) /
            (*textEditStrucHdl)->lineHeight) *
            (*textEditStrucHdl)->lineHeight) +
            (*textEditStrucHdl)->viewRect.top;
        (*textEditStrucHdl)->destRect.bottom = (*textEditStrucHdl)->viewRect.bottom;
    }
}
```

```

    TEActivate(textEditStrucHdl);
    ActivateControl((*docStrucHdl)->vScrollbarRef);
    doAdjustScrollbar(windowRef);
    doAdjustCursor(windowRef);
}
else
{
    TEDeactivate(textEditStrucHdl);
    DeactivateControl((*docStrucHdl)->vScrollbarRef);
}
}

// ***** doNewDocWindow

WindowRef doNewDocWindow(void)
{
    WindowRef      windowRef;
    OSStatus       osError;
    Rect           contentRect = { 100,100,400,595 };
    WindowAttributes attributes = kWindowStandardHandlerAttribute |
                                kWindowStandardDocumentAttributes;

    docStructureHandle docStrucHdl;
    Rect              portRect, destAndViewRect;
    EventTypeSpec     windowEvents[] = { { kEventClassWindow, kEventWindowDrawContent },
                                         { kEventClassWindow, kEventWindowActivated },
                                         { kEventClassWindow, kEventWindowDeactivated },
                                         { kEventClassWindow, kEventWindowClickContentRgn },
                                         { kEventClassWindow, kEventWindowClose },
                                         { kEventClassMouse, kEventMouseDown },
                                         { kEventClassKeyboard, kEventRawKeyDown },
                                         { kEventClassKeyboard, kEventRawKeyRepeat } };

    osError = CreateNewWindow(kDocumentWindowClass, attributes, &contentRect, &windowRef);
    if(osError != noErr)
    {
        doErrorAlert(eWindow);
        return NULL;
    }

    ChangeWindowAttributes(windowRef, 0, kWindowResizableAttribute);
    RepositionWindow(windowRef, NULL, kWindowCascadeOnMainScreen);
    SetWTitle(windowRef, "\puntitled");
    SetPortWindowPort(windowRef);
    TextSize(10);

    InstallWindowEventHandler(windowRef, doGetHandlerUPP(), GetEventTypeCount(windowEvents),
                             windowEvents, 0, NULL);

    if(!(docStrucHdl = (docStructureHandle) NewHandle(sizeof(docStructure))))
    {
        doErrorAlert(eDocStructure);
        return NULL;
    }
    SetWRefCon(windowRef, (SInt32) docStrucHdl);
}

```

```

gNumberOfWindows ++;

(*docStrucHdl)->vScrollbarRef = GetNewControl(rVScrollbar,windowRef);

GetWindowPortBounds(windowRef,&portRect);
destAndViewRect = portRect;
destAndViewRect.right -= 15;
destAndViewRect.bottom -= 15;
InsetRect(&destAndViewRect,2,2);

MoveHHi((Handle) docStrucHdl);
HLock((Handle) docStrucHdl);

if(!((*docStrucHdl)->textEditStrucHdl = TNew(&destAndViewRect,&destAndViewRect)))
{
    DisposeWindow(windowRef);
    gNumberOfWindows --;
    DisposeHandle((Handle) docStrucHdl);
    doErrorAlert(eEditRecord);
    return NULL;
}

HUnlock((Handle) docStrucHdl);

TESetClickLoop(gCustomClickLoopUPP,(*docStrucHdl)->textEditStrucHdl);
TEAutoView(true,(*docStrucHdl)->textEditStrucHdl);
TEFeatureFlag(teFOutlineHilite,1,(*docStrucHdl)->textEditStrucHdl);

ShowWindow(windowRef);

return windowRef;
}

// ***** doGetHandlerUPP

EventHandlerUPP doGetHandlerUPP(void)
{
    static EventHandlerUPP windowEventHandlerUPP;

    if(windowEventHandlerUPP == NULL)
        windowEventHandlerUPP = NewEventHandlerUPP((EventHandlerProcPtr) windowEventHandler);

    return windowEventHandlerUPP;
}

// ***** customClickLoop

Boolean customClickLoop(void)
{
    WindowRef          windowRef;
    docStructureHandle docStrucHdl;
    TEHandle            textEditStrucHdl;
    GrafPtr            oldPort;
    RgnHandle           oldClip;

```

```

Rect            tempRect, portRect;
Point           mouseXY;
SInt16          linesToScroll = 0;

windowRef = FrontWindow();
docStrucHdl = (docStructureHandle) (GetWRefCon(windowRef));
textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

GetPort(&oldPort);
SetPortWindowPort(windowRef);
oldClip = NewRgn();
GetClip(oldClip);
SetRect(&tempRect, -32767, -32767, 32767, 32767);
ClipRect(&tempRect);

GetMouse(&mouseXY);
GetWindowPortBounds(windowRef, &portRect);

if(mouseXY.v < portRect.top)
{
    linesToScroll = 1;
    doSetScrollBarValue((*docStrucHdl)->vScrollBarRef, &linesToScroll);
    if(linesToScroll != 0)
        TESScroll(0, linesToScroll * ((*textEditStrucHdl)->lineHeight), textEditStrucHdl);
}
else if(mouseXY.v > portRect.bottom)
{
    linesToScroll = -1;
    doSetScrollBarValue((*docStrucHdl)->vScrollBarRef, &linesToScroll);
    if(linesToScroll != 0)
        TESScroll(0, linesToScroll * ((*textEditStrucHdl)->lineHeight), textEditStrucHdl);
}

if(linesToScroll != 0)
    doDrawDataPanel(windowRef);

SetClip(oldClip);
DisposeRgn(oldClip);
SetPort(oldPort);

return true;
}

// ***** doSetScrollBarValue

void doSetScrollBarValue(ControlRef controlRef, SInt16 *linesToScroll)
{
    SInt16 controlValue, controlMax;

    controlValue = GetControlValue(controlRef);
    controlMax = GetControlMaximum(controlRef);

```

```

*linesToScroll = controlValue - *linesToScroll;
if(*linesToScroll < 0)
    *linesToScroll = 0;
else if(*linesToScroll > controlMax)
    *linesToScroll = controlMax;

SetControlValue(controlRef,*linesToScroll);
*linesToScroll = controlValue - *linesToScroll;
}

// ***** doAdjustMenus

void doAdjustMenus(void)
{
    MenuRef          fileMenuHdl, editMenuHdl;
    WindowRef        windowRef;
    docStructureHandle docStrucHdl;
    TEHandle          textEditStrucHdl;
    ScrapRef          scrapRef;
    OSStatus          osError;
    ScrapFlavorFlags  scrapFlavorFlags;

    fileMenuHdl = GetMenuRef(mFile);
    editMenuHdl = GetMenuRef(mEdit);

    if(gNumberOfWindows > 0)
    {
        windowRef = FrontWindow();
        docStrucHdl = (docStructureHandle) (GetWRefCon(windowRef));
        textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

        EnableMenuItem(fileMenuHdl,iClose);

        if((*textEditStrucHdl)->selStart < (*textEditStrucHdl)->selEnd)
        {
            EnableMenuItem(editMenuHdl,iCut);
            EnableMenuItem(editMenuHdl,iCopy);
            EnableMenuItem(editMenuHdl,iClear);
        }
        else
        {
            DisableMenuItem(editMenuHdl,iCut);
            DisableMenuItem(editMenuHdl,iCopy);
            DisableMenuItem(editMenuHdl,iClear);
        }
    }

    GetCurrentScrap(&scrapRef);

    osError = GetScrapFlavorFlags(scrapRef,kScrapFlavorTypeText,&scrapFlavorFlags);
    if(osError == noErr)
        EnableMenuItem(editMenuHdl,iPaste);
    else
        DisableMenuItem(editMenuHdl,iPaste);
}

```



```

        if ((*textEditStrucHdl)->teLength > 0)
        {
            EnableMenuItem(fileMenuHdl,iSaveAs);
            EnableMenuItem(editMenuHdl,iSelectAll);
        }
        else
        {
            DisableMenuItem(fileMenuHdl,iSaveAs);
            DisableMenuItem(editMenuHdl,iSelectAll);
        }
    }
    else
    {
        DisableMenuItem(fileMenuHdl,iClose);
        DisableMenuItem(fileMenuHdl,iSaveAs);
        DisableMenuItem(editMenuHdl,iClear);
        DisableMenuItem(editMenuHdl,iSelectAll);
    }

    DrawMenuBar();
}

// ***** doMenuChoice

void doMenuChoice(MenuID menuID, MenuItemIndex menuItem)
{
    if(menuID == 0)
        return;

    if(gRunningOnX)
        if(menuID == gHelpMenu)
            if(menuItem == 1)
                doHelp();

    switch(menuID)
    {
        case mAppleApplication:
            if(menuItem == iAbout)
                SysBeep(10);
            else if(menuItem == iHelp)
                doHelp();
            break;

        case mFile:
            doFileMenu(menuItem);
            break;

        case mEdit:
            doEditMenu(menuItem);
            break;
    }
}

```

```
// ***** doFileMenu

void doFileMenu(MenuBarItem menuItem)
{
    WindowRef      windowRef;
    docStructureHandle docStrucHdl;
    TEHandle        textEditStrucHdl;

    switch(menuItem)
    {
        case iNew:
            if(windowRef = doNewDocWindow())
                ShowWindow(windowRef);
            break;

        case iOpen:
            doOpenCommand();
            doAdjustScrollbar(FrontWindow());
            break;

        case iClose:
            doCloseWindow(FrontWindow());
            break;

        case iSaveAs:
            docStrucHdl = (docStructureHandle) (GetWRefCon(FrontWindow()));
            textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;
            doSaveAsFile(textEditStrucHdl);
            break;
    }
}

// ***** doEditMenu

void doEditMenu(MenuBarItem menuItem)
{
    WindowRef      windowRef;
    docStructureHandle docStrucHdl;
    TEHandle        textEditStrucHdl;
    SInt32          totalSize, contigSize, newSize;
    SInt16           selectionLength;
    ScrapRef        scrapRef;
    Size            sizeOfTextData;

    windowRef = FrontWindow();

    docStrucHdl = (docStructureHandle) (GetWRefCon(windowRef));
    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

    switch(menuItem)
    {
        case iUndo:
            break;
    }
}
```

```

case iCut:
    if(ClearCurrentScrap() == noErr)
    {
        PurgeSpace(&totalSize,&contigSize);
        selectionLength = doGetSelectLength(textEditStrucHdl);
        if(selectionLength > contigSize)
            doErrorAlert(eNoSpaceCut);
        else
        {
            TECut(textEditStrucHdl);
            doAdjustScrollbar(windowRef);
            TEToScrap();
            if(TEToScrap() != noErr)
                ClearCurrentScrap();
        }
    }
    break;

case iCopy:
    if(ClearCurrentScrap() == noErr)
        TEToScrap();
    if(TEToScrap() != noErr)
        ClearCurrentScrap();
    break;

case iPaste:
    GetCurrentScrap(&scrapRef);
    GetScrapFlavorSize(scrapRef,kScrapFlavorTypeText,&sizeOfTextData);
    newSize = (*textEditStrucHdl)->teLength + sizeOfTextData;
    if(newSize > kMaxTELength)
        doErrorAlert(eNoSpacePaste);
    else
    {
        if(TEToScrap() == noErr)
        {
            TEPaste(textEditStrucHdl);
            doAdjustScrollbar(windowRef);
        }
    }
    break;

case iClear:
    TETelete(textEditStrucHdl);
    doAdjustScrollbar(windowRef);
    break;

case iSelectAll:
    TETelete(0,(*textEditStrucHdl)->teLength,textEditStrucHdl);
    break;
}

```

```

doDrawDataPanel(windowRef);
}

// ***** doGetSelectLength

SInt16 doGetSelectLength(TEHandle textEditStrucHdl)
{
    SInt16 selectionLength;

    selectionLength = (*textEditStrucHdl)->selEnd - (*textEditStrucHdl)->selStart;
    return selectionLength;
}

// ***** doAdjustScrollbar

void doAdjustScrollbar(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    TEHandle          textEditStrucHdl;
    SInt16            numberOfLines, controlMax, controlValue;

    docStrucHdl = (docStructureHandle) (GetWRefCon(windowRef));
    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

    numberOfLines = (*textEditStrucHdl)->nLines;
    if ((*textEditStrucHdl)->hText + (*textEditStrucHdl)->teLength - 1) == kReturn)
        numberOfLines += 1;

    controlMax = numberOfLines - (((*textEditStrucHdl)->viewRect.bottom -
        (*textEditStrucHdl)->viewRect.top) /
        (*textEditStrucHdl)->lineHeight);
    if (controlMax < 0)
        controlMax = 0;
    SetControlMaximum((*docStrucHdl)->vScrollbarRef, controlMax);

    controlValue = ((*textEditStrucHdl)->viewRect.top - (*textEditStrucHdl)->destRect.top) /
        (*textEditStrucHdl)->lineHeight;
    if (controlValue < 0)
        controlValue = 0;
    else if (controlValue > controlMax)
        controlValue = controlMax;

    SetControlValue((*docStrucHdl)->vScrollbarRef, controlValue);

    SetControlViewSize((*docStrucHdl)->vScrollbarRef, (*textEditStrucHdl)->viewRect.bottom -
        (*textEditStrucHdl)->viewRect.top);

    TEScroll(0, ((*textEditStrucHdl)->viewRect.top - (*textEditStrucHdl)->destRect.top) -
        (GetControlValue((*docStrucHdl)->vScrollbarRef) *
        (*textEditStrucHdl)->lineHeight), textEditStrucHdl);
}

```

```
// ***** doAdjustCursor

void doAdjustCursor(WindowRef windowRef)
{
    GrafPtr    oldPort;
    RgnHandle   arrowRegion, iBeamRegion;
    Rect        portRect, cursorRect;
    Point       mouseXY;

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    arrowRegion = NewRgn();
    iBeamRegion = NewRgn();
    SetRectRgn(arrowRegion, -32768, -32768, 32766, 32766);

    GetWindowPortBounds(windowRef, &portRect);
    cursorRect = portRect;
    cursorRect.bottom -= 15;
    cursorRect.right -= 15;
    LocalToGlobal(&topLeft(cursorRect));
    LocalToGlobal(&botRight(cursorRect));

    RectRgn(iBeamRegion, &cursorRect);
    DiffRgn(arrowRegion, iBeamRegion, arrowRegion);

    GetGlobalMouse(&mouseXY);

    if(PtInRgn(mouseXY, iBeamRegion))
        SetThemeCursor(kThemeIBeamCursor);
    else
        SetThemeCursor(kThemeArrowCursor);

    DisposeRgn(arrowRegion);
    DisposeRgn(iBeamRegion);

    SetPort(oldPort);
}

// ***** doCloseWindow

void doCloseWindow(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;

    docStrucHdl = (docStructureHandle) (GetWRefCon(windowRef));

    DisposeControl((*docStrucHdl)->vScrollbarRef);
    TEDispose((*docStrucHdl)->textEditStrucHdl);
    DisposeHandle((Handle) docStrucHdl);
    DisposeWindow(windowRef);

    gNumberOfWindows --;
}
```

```
// ***** doSaveAsFile

void doSaveAsFile(TEHandle textEditStrucHdl)
{
    OSErr          osError = noErr;
    NavDialogOptions dialogOptions;
    NavEventUPP     navEventFunctionUPP;
    WindowRef       windowRef;
    OSType          fileType;
    NavReplyRecord   navReplyStruc;
    AEKeyword        theKeyword;
    DescType         actualType;
    FSSpec           fileSpec;
    SInt16           fileRefNum;
    Size             actualSize;
    SInt32           dataLength;
    Handle           editTextHdl;

    osError = NavGetDefaultDialogOptions(&dialogOptions);

    if(osError == noErr)
    {
        windowRef = FrontWindow();

        fileType = 'TEXT';

        navEventFunctionUPP = NewNavEventUPP((NavEventProcPtr) navEventFunction);
        osError = NavPutFile(NULL,&navReplyStruc,&dialogOptions,navEventFunctionUPP,fileType,
                               'kJBb',NULL);
        DisposeNavEventUPP(navEventFunctionUPP);

        if(navReplyStruc.validRecord && osError == noErr)
        {
            if((osError = AEGGetNthPtr(&(navReplyStruc.selection),1,typeFSS,&theKeyword,
                                       &actualType,&fileSpec,sizeof(fileSpec),&actualSize)) == noErr)
            {
                if(!navReplyStruc.replacing)
                {
                    osError = FSpCreate(&fileSpec,'kJBb',fileType,navReplyStruc.keyScript);
                    if(osError != noErr)
                    {
                        NavDisposeReply(&navReplyStruc);
                    }
                }
            }

            if(osError == noErr)
                osError = FSpOpenDF(&fileSpec,fsRdWrPerm,&fileRefNum);

            if(osError == noErr)
            {
                SetWTitle(windowRef,fileSpec.name);
                dataLength = (*textEditStrucHdl)->teLength;
                editTextHdl = (*textEditStrucHdl)->hText;
                FSWrite(fileRefNum,&dataLength,*editTextHdl);
            }
        }
    }
}
```

```

        NavCompleteSave(&navReplyStruc,kNavTranslateInPlace);
    }

    NavDisposeReply(&navReplyStruc);
}
}
}

// ***** doOpenCommand

void doOpenCommand(void)
{
    OSErr          osError = noErr;
    NavDialogOptions dialogOptions;
    NavEventUPP     navEventFunctionUPP;
    NavReplyRecord   navReplyStruc;
    SInt32           index, count;
    AEKeyword        theKeyword;
    DescType         actualType;
    FSSpec           fileSpec;
    Size             actualSize;
    FInfo            fileInfo;

    osError = NavGetDefaultDialogOptions(&dialogOptions);

    if(osError == noErr)
    {
        navEventFunctionUPP = NewNavEventUPP((NavEventProcPtr) navEventFunction);
        osError = NavGetFile(NULL,&navReplyStruc,&dialogOptions,navEventFunctionUPP,NULL,NULL,
                               NULL,NULL);
        DisposeNavEventUPP(navEventFunctionUPP);

        if(osError == noErr && navReplyStruc.validRecord)
        {
            osError = AECountItems(&(navReplyStruc.selection),&count);
            if(osError == noErr)
            {
                for(index=1;index<=count;index++)
                {
                    osError = AEGetNthPtr(&(navReplyStruc.selection),index,typeFSS,&theKeyword,
                                           &actualType,&fileSpec,sizeof(fileSpec),&actualSize);
                    {
                        if((osError = FSpGetFInfo(&fileSpec,&fileInfo)) == noErr)
                            doOpenFile(fileSpec);
                    }
                }
            }
        }

        NavDisposeReply(&navReplyStruc);
    }
}

```

```
// ***** doOpenFile

void doOpenFile(FSSpec fileSpec)
{
    WindowRef      windowRef;
    docStructureHandle docStrucHdl;
    TEHandle        textEditStrucHdl;
    SInt16          fileRefNum;
    SInt32          textLength;
    Handle          textBuffer;

    if((windowRef = doNewDocWindow()) == NULL)
        return;

    docStrucHdl = (docStructureHandle) (GetWRefCon(windowRef));
    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

    SetWTitle(windowRef, fileSpec.name);

    FSpOpenDF(&fileSpec, fsCurPerm, &fileRefNum);

    SetFPos(fileRefNum, fsFromStart, 0);
    GetEOF(fileRefNum, &textLength);

    if(textLength > 32767)
        textLength = 32767;

    textBuffer = NewHandle((Size) textLength);

    FSRead(fileRefNum, &textLength, *textBuffer);

    MoveHHi(textBuffer);
    HLock(textBuffer);

    TESSetText(*textBuffer, textLength, textEditStrucHdl);

    HUnlock(textBuffer);
    DisposeHandle(textBuffer);

    FSClose(fileRefNum);

    (*textEditStrucHdl)->selStart = 0;
    (*textEditStrucHdl)->selEnd = 0;

    doDrawContent(windowRef);
}

// ***** doDrawDataPanel

void doDrawDataPanel(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    TEHandle          textEditStrucHdl;
    RGBColor          whiteColor = { 0xFFFF, 0xFFFF, 0xFFFF };

```



```

RGBColor      blackColor = { 0x0000, 0x0000, 0x0000 };
RGBColor      blueColor = { 0x1818, 0x4B4B, 0x8181 };
ControlRef    controlRef;
Rect          panelRect;
Str255        textString;

SetPortWindowPort(windowRef);

docStrucHdl = (docStructureHandle) (GetWRefCon(windowRef));
textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;
controlRef = (*docStrucHdl)->vScrollbarRef;

MoveTo(0,282);
LineTo(495,282);

RGBForeColor(&whiteColor);
RGBBackColor(&blueColor);
SetRect(&panelRect,0,283,495,300);
EraseRect(&panelRect);

MoveTo(3,295);
DrawString("\pteLength          nLines          lineHeight");

MoveTo(225,295);
DrawString("\pdestRect.top          controlValue          contrlMax");

SetRect(&panelRect,47,284,88,299);
EraseRect(&panelRect);
SetRect(&panelRect,124,284,149,299);
EraseRect(&panelRect);
SetRect(&panelRect,204,284,222,299);
EraseRect(&panelRect);
SetRect(&panelRect,286,284,323,299);
EraseRect(&panelRect);
SetRect(&panelRect,389,284,416,299);
EraseRect(&panelRect);
SetRect(&panelRect,472,284,495,299);
EraseRect(&panelRect);

NumToString((SInt32) (*textEditStrucHdl)->teLength,textString);
MoveTo(47,295);
DrawString(textString);

NumToString((SInt32) (*textEditStrucHdl)->nLines,textString);
MoveTo(124,295);
DrawString(textString);

NumToString((SInt32) (*textEditStrucHdl)->lineHeight,textString);
MoveTo(204,295);
DrawString(textString);

NumToString((SInt32) (*textEditStrucHdl)->destRect.top,textString);
MoveTo(286,295);
DrawString(textString);

```

```

NumToString((SInt32) GetControlValue(controlRef),textString);
MoveTo(389,295);
DrawString(textString);

NumToString((SInt32) GetControlMaximum(controlRef),textString);
MoveTo(472,295);
DrawString(textString);

RGBForeColor(&blackColor);
RGBBackColor(&whiteColor);
}

// ***** doErrorAlert

void doErrorAlert(SInt16 errorCode)
{
    Str255 errorString;
    SInt16 itemHit;

    GetIndString(errorString,rErrorStrings,errorCode);

    if(errorCode < eWindow)
    {
        StandardAlert(kAlertStopAlert,errorString,NULL,NULL,&itemHit);
        ExitToShell();
    }
    else
    {
        StandardAlert(kAlertCautionAlert,errorString,NULL,NULL,&itemHit);
    }
}

// ***** navEventFunction

void navEventFunction(NavEventCallbackMessage callBackSelector,NavCBRecPtr callBackParms,
                     NavCallBackUserData callBackUD)
{
}

// *****
// HelpDialog.c
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define eHelpDialog            8
#define eHelpDocStructure     9
#define eHelpText             10
#define eHelpPicture          11
#define eHelpControls         12

```

```

#define rTextIntroduction      128
#define rTextCreatingText     129
#define rTextModifyHelp       130
#define rPictIntroductionBase  128
#define rPictCreatingTextBase 129
#define kTextInset             4

// ..... typedefs

typedef struct
{
    Rect      bounds;
    PicHandle pictureHdl;
} pictInfoStructure;

typedef struct
{
    TEHandle      textEditStrucHdl;
    ControlRef    scrollbarHdl;
    SInt16        pictCount;
    pictInfoStructure *pictInfoStructurePtr;
} docStructure, ** docStructureHandle;

typedef struct
{
    RGBColor      backColor;
    PixPatHandle  backPixelPattern;
    Pattern       backBitPattern;
} backColorPattern;

// ..... global variables

GrafPtr          gOldPort;
EventHandlerUPP   helpWindowEventHandlerUPP;
ControlUserPaneDrawUPP userPaneDrawFunctionUPP;
ControlActionUPP  actionFunctionUPP;
SInt16           gTextResourceID;
SInt16           gPictResourceBaseID;
RgnHandle        gSavedClipRgn = NULL;

// ..... function prototypes

void      doHelp                (void);
OSStatus  helpWindowEventHandler (EventHandlerCallRef, EventRef, void *);
void      userPaneDrawFunction   (ControlRef, SInt16);
Boolean   doGetText              (WindowRef, SInt16, Rect);
Boolean   doGetPictureInfo       (WindowRef, SInt16);
void      actionFunction          (ControlRef, SInt16);
void      doScrollTextAndPicts   (WindowRef);
void      doDrawPictures         (WindowRef, Rect *);
void      doCloseHelp            (WindowRef);
void      doDisposeDescriptors   (void);
void      doSetBackgroundWhite    (void);

extern void doErrorAlert          (SInt16);

```

```
// ***** doHelp

void doHelp(void)
{
    OSStatus      osError;
    WindowRef     windowRef;
    docStructureHandle docStrucHdl;
    ControlRef     controlRef;
    ControlID      controlID;
    Rect           windowRect      = { 0, 0, 353,382 };
    Rect           pushButtonRect  = { 312,297,332,366 };
    Rect           userPaneRect    = { 16, 16, 296,351 };
    Rect           scrollBarRect    = { 16, 350,296,366 };
    Rect           popupButtonRect = { 312,12, 332,256 };
    Rect           destRect, viewRect;
    EventTypeSpec  dialogEvents[] = { { kEventClassControl, kEventControlClick } };

    GetPort(&gOldPort);

    // ..... create universal procedure pointers

    helpWindowEventHandlerUPP = NewEventHandlerUPP((EventHandlerProcPtr)
                                                    helpWindowEventHandler);
    userPaneDrawFunctionUPP = NewControlUserPaneDrawUPP((ControlUserPaneDrawProcPtr)
                                                         userPaneDrawFunction);
    actionFunctionUPP = NewControlActionUPP((ControlActionProcPtr) actionFunction);

    // ..... create modal class window

    osError = CreateNewWindow(kMovableModalWindowClass,kWindowStandardHandlerAttribute,
                              &windowRect,&windowRef);
    if(osError == noErr)
    {
        RepositionWindow(windowRef,FrontWindow(),kWindowAlertPositionOnMainScreen);
        SetThemeWindowBackground(windowRef,kThemeBrushDialogBackgroundActive,false);

        InstallWindowEventHandler(windowRef,helpWindowEventHandlerUPP,
                                  GetEventTypeCount(dialogEvents),dialogEvents,windowRef,NULL);

        if(!(docStrucHdl = (docStructureHandle) NewHandle(sizeof(docStructure))))
        {
            doErrorAlert(eHelpDocStructure);
            DisposeWindow(windowRef);
            doDisposeDescriptors();
            return;
        }

        SetWRefCon(windowRef,(SInt32) docStrucHdl);
        SetPortWindowPort(windowRef);

        // ..... create root, push button, user pane, and scroll bar controls

        CreateRootControl(windowRef,&controlRef);
    }
}
```

```

if((osError = CreatePushButtonControl(windowRef,&pushButtonRect,CFSTR("OK"),&controlRef))
    == noErr)
{
    SetWindowDefaultButton(windowRef,controlRef);
    controlID.id = 'done';
    SetControlID(controlRef,&controlID);
}

if(osError == noErr)
{
    if((osError = CreateUserPaneControl(windowRef,&userPaneRect,0,&controlRef)) == noErr)
    {
        SetControlData(controlRef,kControlEntireControl,kControlUserPaneDrawProcTag,
            sizeof(userPaneDrawFunctionUPP),(Ptr) &userPaneDrawFunctionUPP);
    }
}

if(osError == noErr)
{
    if((osError = CreateScrollBarControl(windowRef,&scrollBarRect,0,0,1,0,true,
        actionFunctionUPP,&controlRef)) == noErr)
    {
        (*docStrucHdl)->scrollbarHdl = controlRef;
        controlID.id = 'scro';
        SetControlID(controlRef,&controlID);
    }
}

if(osError == noErr)
{
    if((osError = CreatePopupButtonControl(windowRef,&popupButtonRect,CFSTR("Title:"),131,
        false,-1,0,0,&controlRef)) == noErr)
    {
        controlID.id = 'popu';
        SetControlID(controlRef,&controlID);
    }
}

if(osError != noErr)
{
    doErrorAlert(eHelpControls);
    DisposeWindow(windowRef);
    doDisposeDescriptors();
    return;
}
}
else
{
    doErrorAlert(eHelpDialog);
    doDisposeDescriptors();
    return;
}
// ..... set destination and view rectangles, create TextEdit structure

InsetRect(&userPaneRect,kTextInset,kTextInset / 2);
destRect = viewRect = userPaneRect;
(*docStrucHdl)->textEditStrucHdl = TESTyleNew(&destRect,&viewRect);

```

```
// ..... initialise picture information structure field of document structure
(*docStrucHdl)->pictInfoStructurePtr = NULL;

// ..... assign resource IDs of first topic's 'TEXT'/'styl' resources
gTextResourceID      = rTextIntroduction;
gPictResourceBaseID  = rPictIntroductionBase;

// ..... load text resources and insert into edit structure
if(!(doGetText(windowRef,gTextResourceID,viewRect)))
{
    doCloseHelp(windowRef);
    doDisposeDescriptors();
    return;
}

// ..... search for option-space charas in text and load same number of 'PICT' resources
if(!(doGetPictureInfo(windowRef,gPictResourceBaseID)))
{
    doCloseHelp(windowRef);
    doDisposeDescriptors();
    return;
}

// ..... create an empty region for saving the old clipping region
gSavedClipRgn = NewRgn();

// ..... show window and run modal loop
ShowWindow(windowRef);
RunAppModalLoopForWindow(windowRef);
}

// ***** helpWindowEventHandler

OSStatus  helpWindowEventHandler(EventHandlerCallRef eventHandlerCallRef,EventRef eventRef,
                                void *userData)
{
    OSStatus      result = eventNotHandledErr;
    WindowRef     windowRef;
    UInt32        eventClass;
    UInt32        eventKind;
    Point          mouseLocation;
    ControlRef     controlRef;
    ControlPartCode controlPartCode;
    ControlID      controlId;
    MenuItemIndex  menuItem;
    docStructureHandle docStrucHdl;
    TEHandle       textEditStrucHdl;
    Rect           viewRect;
```

```

windowRef = userData;
eventClass = GetEventClass(eventRef);
eventKind = GetEventKind(eventRef);

if(eventClass == kEventClassControl)
{
    if(eventKind == kEventControlClick)
    {
        GetEventParameter(eventRef, kEventParamMouseLocation, typeQDPoint, NULL,
                           sizeof(mouseLocation), NULL, &mouseLocation);
        GlobalToLocal(&mouseLocation);
        controlRef = FindControlUnderMouse(mouseLocation, windowRef, &controlPartCode);
        if(controlRef)
        {
            GetControlID(controlRef, &controlID);
            if(controlID.id == 'done') // push button
            {
                if(TrackControl(controlRef, mouseLocation, NULL))
                {
                    QuitAppModalLoopForWindow(windowRef);
                    doCloseHelp(windowRef);
                    doDisposeDescriptors();
                    result = noErr;
                }
            }
            if(controlID.id == 'scro') // scroll bar
            {
                TrackControl(controlRef, mouseLocation, actionFunctionUPP);
                result = noErr;
            }
            else if(controlID.id == 'popu') // pop-up menu button
            {
                TrackControl(controlRef, mouseLocation, (ControlActionUPP) -1);
                menuItem = GetControlValue(controlRef);
                switch(menuItem)
                {
                    case 1:
                        gTextResourceID = rTextIntroduction;
                        gPictResourceBaseID = rPictIntroductionBase;
                        break;

                    case 2:
                        gTextResourceID = rTextCreatingText;
                        gPictResourceBaseID = rPictCreatingTextBase;
                        break;

                    case 3:
                        gTextResourceID = rTextModifyHelp;
                        break;
                }
            }

            docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
            textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;
            viewRect = (*textEditStrucHdl)->viewRect;

```

```

    if(! (doGetText(windowRef,gTextResourceID,viewRect)))
    {
        doCloseHelp(windowRef);
        doDisposeDescriptors();
        return;
    }

    if(! (doGetPictureInfo(windowRef,gPictResourceBaseID)))
    {
        doCloseHelp(windowRef);
        doDisposeDescriptors();
        return;
    }

    doDrawPictures(windowRef,&viewRect);

    result = noErr;
}
}
}
}

return result;
}

// ***** userPaneDrawFunction

void userPaneDrawFunction(ControlRef controlRef,SInt16 thePart)
{
    Rect          itemRect, viewRect;
    WindowRef     windowRef;
    docStructureHandle docStrucHdl;
    TEHandle      textEditStrucHdl;
    Boolean        inState;

    windowRef = GetControlOwner(controlRef);

    GetControlBounds(controlRef,&itemRect);
    InsetRect(&itemRect,1,1);
    itemRect.right += 15;

    if(IsWindowVisibile(windowRef))
        inState = IsWindowHilited(windowRef);
    DrawThemeListBoxFrame(&itemRect,inState);

    doSetBackgroundWhite();
    EraseRect(&itemRect);

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;
    viewRect = (*textEditStrucHdl)->viewRect;

    TEUpdate(&viewRect,textEditStrucHdl);
    doDrawPictures(windowRef,&viewRect);
}

```



```
// ***** doGetText

Boolean doGetText(WindowRef windowRef,SInt16 textResourceID,Rect viewRect)
{
    docStructureHandle docStrucHdl;
    TEHandle          textEditStrucHdl;
    Handle            helpTextHdl;
    StScrpHandle       stylScrpStrucHdl;
    SInt16             numberOfLines, heightOfText, heightToScroll;

    doSetBackgroundWhite();

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

    TESetSelect(0,32767,textEditStrucHdl);
    TDelete(textEditStrucHdl);

    (*textEditStrucHdl)->destRect = (*textEditStrucHdl)->viewRect;
    SetControlValue((*docStrucHdl)->scrollbarHdl,0);

    helpTextHdl = GetResource('TEXT',textResourceID);
    if(helpTextHdl == NULL)
    {
        doErrorAlert(eHelpText);
        return false;
    }

    stylScrpStrucHdl = (StScrpHandle) GetResource('styl',textResourceID);
    if(stylScrpStrucHdl == NULL)
    {
        doErrorAlert(eHelpText);
        return false;
    }

    TStyleInsert(*helpTextHdl,GetHandleSize(helpTextHdl),stylScrpStrucHdl,textEditStrucHdl);

    ReleaseResource(helpTextHdl);
    ReleaseResource((Handle) stylScrpStrucHdl);

    numberOfLines = (*textEditStrucHdl)->nLines;
    heightOfText = TGetHeight((SInt32) numberOfLines,1,textEditStrucHdl);

    if(heightOfText > (viewRect.bottom - viewRect.top))
    {
        heightToScroll = TGetHeight((SInt32) numberOfLines,1,textEditStrucHdl) -
            (viewRect.bottom - viewRect.top);
        SetControlMaximum((*docStrucHdl)->scrollbarHdl,heightToScroll);
        ActivateControl((*docStrucHdl)->scrollbarHdl);
        SetControlViewSize((*docStrucHdl)->scrollbarHdl,(*textEditStrucHdl)->viewRect.bottom -
            (*textEditStrucHdl)->viewRect.top);
    }
    else
    {
        DeactivateControl((*docStrucHdl)->scrollbarHdl);
    }
}
```

```

    return true;
}

// ***** doGetPictureInfo

Boolean doGetPictureInfo(WindowRef windowRef, SInt16 firstPictID)
{
    docStructureHandle docStrucHdl;
    TEHandle            textEditStrucHdl;
    Handle              textHdl;
    SInt32              offset, textSize;
    SInt16              numberOfPicts, a, lineHeight, fontAscent;
    SInt8               optionSpace[1] = "\xCA";
    pictInfoStructure   *pictInfoPtr;
    Point               picturePoint;
    TextStyle           whatStyle;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

    if((*docStrucHdl)->pictInfoStructurePtr != NULL)
    {
        for(a=0; a<(*docStrucHdl)->pictCount; a++)
            ReleaseResource((Handle) (*docStrucHdl)->pictInfoStructurePtr[a].pictureHdl);

        DisposePtr((Ptr) (*docStrucHdl)->pictInfoStructurePtr);
        (*docStrucHdl)->pictInfoStructurePtr = NULL;
    }

    (*docStrucHdl)->pictCount = 0;

    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;
    textHdl = (*textEditStrucHdl)->hText;

    textSize = GetHandleSize(textHdl);
    offset = 0;
    numberOfPicts = 0;

    HLock(textHdl);

    offset = Munger(textHdl, offset, optionSpace, 1, NULL, 0);
    while((offset >= 0) && (offset <= textSize))
    {
        numberOfPicts++;
        offset++;
        offset = Munger(textHdl, offset, optionSpace, 1, NULL, 0);
    }

    if(numberOfPicts == 0)
    {
        HUnlock(textHdl);
        return true;
    }

    pictInfoPtr = (pictInfoStructure *) NewPtr(sizeof(pictInfoStructure) * numberOfPicts);
    (*docStrucHdl)->pictInfoStructurePtr = pictInfoPtr;

```

```

offset = 0L;

for(a=0;a<numberOfPicts;a++)
{
    pictInfoPtr[a].pictureHdl = GetPicture(firstPictID + a);
    if(pictInfoPtr[a].pictureHdl == NULL)
    {
        doErrorAlert(eHelpPicture);
        return false;
    }

    offset = Munger(textHdl,offset,optionSpace,1,NULL,0);
    picturePoint = TEGetPoint((SInt16)offset,textEditStrucHdl);

    TEGetStyle(offset,&whatStyle,&lineHeight,&fontAscent,textEditStrucHdl);
    picturePoint.v -= lineHeight;
    offset++;
    pictInfoPtr[a].bounds = (**pictInfoPtr[a].pictureHdl).picFrame;

    OffsetRect(&pictInfoPtr[a].bounds,
        (((*textEditStrucHdl)->destRect.right + (*textEditStrucHdl)->destRect.left) -
        (pictInfoPtr[a].bounds.right + pictInfoPtr[a].bounds.left) ) / 2,
        - pictInfoPtr[a].bounds.top + picturePoint.v);
}

(*docStrucHdl)->pictCount = a;

HUnlock(textHdl);

return true;
}

// ***** actionFunction

void actionFunction(ControlRef scrollbarHdl,SInt16 partCode)
{
    WindowRef          windowRef;
    docStructureHandle docStrucHdl;
    TEHandle            textEditStrucHdl;
    SInt16              delta, oldValue, offset, lineHeight, fontAscent;
    Point              thePoint;
    Rect                viewRect, portRect;
    TextStyle           style;

    if(partCode)
    {
        windowRef = GetControlOwner(scrollbarHdl);
        docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
        textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;
        viewRect = (*textEditStrucHdl)->viewRect;
        thePoint.h = viewRect.left + kTextInset;

        if(partCode != kControlIndicatorPart)
        {
            switch(partCode)

```

```

{
    case kControlUpButtonPart:
        thePoint.v = viewRect.top - 4;
        offset = TEGetOffset(thePoint, textEditStrucHdl);
        thePoint = TEGetPoint(offset, textEditStrucHdl);
        TEGetStyle(offset, &style, &lineHeight, &fontAscent, textEditStrucHdl);
        delta = thePoint.v - lineHeight - viewRect.top;
        break;

    case kControlDownButtonPart:
        thePoint.v = viewRect.bottom + 2;
        offset = TEGetOffset(thePoint, textEditStrucHdl);
        thePoint = TEGetPoint(offset, textEditStrucHdl);
        delta = thePoint.v - viewRect.bottom;
        break;

    case kControlPageUpPart:
        thePoint.v = viewRect.top + 2;
        offset = TEGetOffset(thePoint, textEditStrucHdl);
        thePoint = TEGetPoint(offset, textEditStrucHdl);
        TEGetStyle(offset, &style, &lineHeight, &fontAscent, textEditStrucHdl);
        thePoint.v += lineHeight - fontAscent;
        thePoint.v -= viewRect.bottom - viewRect.top;
        offset = TEGetOffset(thePoint, textEditStrucHdl);
        thePoint = TEGetPoint(offset, textEditStrucHdl);
        TEGetStyle(offset, &style, &lineHeight, &fontAscent, textEditStrucHdl);
        delta = thePoint.v - viewRect.top;
        if (offset == 0)
            delta -= lineHeight;
        break;

    case kControlPageDownPart:
        thePoint.v = viewRect.bottom - 2;
        offset = TEGetOffset(thePoint, textEditStrucHdl);
        thePoint = TEGetPoint(offset, textEditStrucHdl);
        TEGetStyle(offset, &style, &lineHeight, &fontAscent, textEditStrucHdl);
        thePoint.v -= fontAscent;
        thePoint.v += viewRect.bottom - viewRect.top;
        offset = TEGetOffset(thePoint, textEditStrucHdl);
        thePoint = TEGetPoint(offset, textEditStrucHdl);
        TEGetStyle(offset, &style, &lineHeight, &fontAscent, textEditStrucHdl);
        delta = thePoint.v - lineHeight - viewRect.bottom;
        if (offset == (**textEditStrucHdl).teLength)
            delta += lineHeight;
        break;
}

oldValue = GetControlValue(scrollbarHdl);

if (((delta < 0) && (oldValue > 0)) || ((delta > 0) &&
    (oldValue < GetControlMaximum(scrollbarHdl))))
{
    GetClip(gSavedClipRgn);
    GetWindowPortBounds(windowRef, &portRect);
    ClipRect(&portRect);
}

```

```

        SetControlValue(scrollbarHdl,oldValue + delta);
        SetClip(gSavedClipRgn);
    }
}

doScrollTextAndPicts(windowRef);
}

// ***** doScrollTextAndPicts

void doScrollTextAndPicts(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    TEHandle           textEditStrucHdl;
    SInt16             scrollDistance, oldScroll;
    Rect               updateRect;

    doSetBackgroundWhite();

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

    oldScroll = (*textEditStrucHdl)->viewRect.top - (*textEditStrucHdl)->destRect.top;
    scrollDistance = oldScroll - GetControlValue((*docStrucHdl)->scrollbarHdl);
    if(scrollDistance == 0)
        return;

    TEScroll(0,scrollDistance,textEditStrucHdl);

    if((*docStrucHdl)->pictCount == 0)
        return;

    updateRect = (*textEditStrucHdl)->viewRect;

    if(scrollDistance > 0)
    {
        if(scrollDistance < (updateRect.bottom - updateRect.top))
            updateRect.bottom = updateRect.top + scrollDistance;
    }
    else
    {
        if(- scrollDistance < (updateRect.bottom - updateRect.top))
            updateRect.top = updateRect.bottom + scrollDistance;
    }

    doDrawPictures(windowRef,&updateRect);
}

```

```
// ***** doDrawPictures
```

```
void doDrawPictures(WindowRef windowRef, Rect *updateRect)
```

```
{
    docStructureHandle docStrucHdl;
    TEHandle            textEditStrucHdl;
    SInt16              pictCount, pictIndex, vOffset;
    PicHandle           thePictHdl;
    Rect                pictLocRect, dummyRect;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

    vOffset = (*textEditStrucHdl)->destRect.top -
              (*textEditStrucHdl)->viewRect.top - kTextInset;
    pictCount = (*docStrucHdl)->pictCount;

    for(pictIndex = 0; pictIndex < pictCount; pictIndex++)
    {
        pictLocRect = (*docStrucHdl)->pictInfoStructurePtr[pictIndex].bounds;
        OffsetRect(&pictLocRect, 0, vOffset);

        if(!SectRect(&pictLocRect, updateRect, &dummyRect))
            continue;

        thePictHdl = (*docStrucHdl)->pictInfoStructurePtr[pictIndex].pictureHdl;

        LoadResource((Handle) thePictHdl);
        HLock((Handle) thePictHdl);

        GetClip(gSavedClipRgn);
        ClipRect(updateRect);
        DrawPicture(thePictHdl, &pictLocRect);

        SetClip(gSavedClipRgn);
        HUnlock((Handle) thePictHdl);
    }
}
```

```
// ***** doCloseHelp
```

```
void doCloseHelp(WindowRef windowRef)
```

```
{
    docStructureHandle docStrucHdl;
    TEHandle            textEditStrucHdl;
    SInt16              a;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    textEditStrucHdl = (*docStrucHdl)->textEditStrucHdl;

    if(gSavedClipRgn)
        DisposeRgn(gSavedClipRgn);
}
```

```

if ((*docStrucHdl)->textEditStrucHdl)
    TEDispose ((*docStrucHdl)->textEditStrucHdl);

if ((*docStrucHdl)->pictInfoStructurePtr)
{
    for(a=0;a<(*docStrucHdl)->pictCount;a++)
        ReleaseResource((Handle) (*docStrucHdl)->pictInfoStructurePtr[a].pictureHdl);
    DisposePtr((Ptr) (*docStrucHdl)->pictInfoStructurePtr);
}

DisposeHandle((Handle) docStrucHdl);
DisposeWindow(windowRef);
SetPort(gOldPort);
}

// ***** doDisposeDescriptors

void doDisposeDescriptors(void)
{
    DisposeEventHandlerUPP(helpWindowEventHandlerUPP);
    DisposeControlUserPaneDrawUPP(userPaneDrawFunctionUPP);
    DisposeControlActionUPP(actionFunctionUPP);
}

// ***** doSetBackgroundWhite

void doSetBackgroundWhite(void)
{
    RGBColor whiteColor = { 0xFFFF, 0xFFFF, 0xFFFF };
    Pattern whitePattern;

    RGBBackColor(&whiteColor);
    BackPat(GetQDGlobalsWhite(&whitePattern));
}

// *****

```

## Demonstration Program MonoTextEdit Comments

When this program is run, the user should explore both the text editor and the Help dialog.

### Text Editor

In the text editor, the user should perform all the actions usually associated with a simple text editor, that is

- Open a new document window, open an existing ‘TEXT’ file for display in a new document window, and save a document to a ‘TEXT’ file. (A ‘TEXT’ file titled “MonoTextEdit Document” is included.)
- Enter new text and use the Edit menu Cut, Copy, Paste, and Clear commands to edit the text. (Pasting between documents and other applications is supported.)



- Select text by clicking and dragging, double-clicking a word, shift-clicking, and choosing the Select All command from the Edit menu. Also select large amounts of text by clicking in the text and dragging the cursor above or below the window so as to invoke auto-scrolling.
- Scroll a large document by dragging the scroll box/scroller (live scrolling is used), clicking once in a scroll arrow or gray area/track, and holding the mouse down in a scroll arrow or gray area/track.

Whenever any action is taken, the user should observe the changes to the values displayed in the data panel at the bottom of each window. In particular, the relationship between the destination rectangle and scroll bar control value should be noted.

The user should also note that outline highlighting is activated for all windows and that the forward-delete key is supported by the application. (The forward-delete key is not supported by TextEdit.)

### Help Dialog

The user should choose MonoTextEdit Help from the Mac OS 8/9 Apple menu or Mac OS X Help menu to open the Help dialog and then scroll through the three help topics, which may be chosen in the pop-up menu at the bottom of the dialog. The help topics contain documentation on the Help dialog that supplements the source code comments below.

## MonoTextEdit.c

### defines

kMaxTELength represents the maximum allowable number of bytes in a TextEdit structure. kTab, kBackSpace, kForwardDelete, kReturn, and kEscape representing the character codes generated by the tab, delete, forward delete, Return and escape keys.

### typedefs

The docStructure data type will be used for a small document structure comprising a handle to a TextEdit structure and a handle to a vertical scroll bar.

### Global Variables

scrollActionFunctionUPP will be assigned a universal procedure pointer to an action (callback) function for the scroll bar. customClickLoopUPP will be assigned a universal procedure pointer to a custom click loop (callback) function. gOldControlValue will be assigned the scroll bar's control value.

### main

The main function creates universal procedure pointers for the application-defined scroll action and custom click loop (callback) functions and installs a timer set to fire repeatedly at the interval returned by a call to GetCaretTime. When the timer fires, the function doIdle is called.



## **windowEventHandler**

When the `kEventClassMouse` event type is received, if the call to `FindControlUnderMouse` reveals that a control (that is, the vertical scroll bar) is under the mouse, `TrackControl` is called with a universal procedure pointer to an action function passed in the third parameter.

When the `kEventRawKeyDown` and `kEventRawKeyRepeat` event types are received, the function `doKeyEvent` is called only if the Command key was not down.

## **doIdle**

`doIdle` is called whenever the installed timer fires.

The first line gets a reference to the front window. If the front window is a document window, a handle to the window's document structure is retrieved. A handle to the `TextEdit` structure associated with the window is stored in the document structure's `textEditStrucHdl` field. This is passed in the call to `TEIdle`, which blinks the insertion point caret.

## **doKeyEvent**

`doKeyEvent` is called when the `kEventRawKeyDown` and `kEventRawKeyRepeat` event types are received. It handles all key-down events that are not Command key equivalents.

If the character code is equal to that for the escape key or lower, and except if it is the carriage return or backspace character, the function simply returns.

The first three lines get a handle to the `TextEdit` structure whose handle is stored in the front window's document structure.

The next line filters out the tab key character code. (`TextEdit` does not support the tab key and some applications may need to provide a tab key handler.)

The next character code to be filtered out is the forward-delete key character code. `TextEdit` does not recognize this key, so this else if block provides forward-delete key support for the program. The first line in this block gets the current selection length from the `TextEdit` structure. If this is zero (that is, there is no selection range and an insertion point is being displayed), the `selEnd` field is incremented by one. This, in effect, creates a selection range comprising the character following the insertion point. `TEDelete` deletes the current selection range from the `TextEdit` structure. Such deletions could change the number of text lines in the `TextEdit` structure, requiring the vertical scroll bar to be adjusted; hence the call to the function `doAdjustScrollbar`.

Processing of those character codes that have not been filtered out is performed in the else block. A new character must not be allowed to be inserted if the `TextEdit` limit of 32,767 characters will be exceeded. Accordingly, and given that `TEKey` replaces the selection range with the character passed to it, the first step is to get the current selection length. If the current

number of characters minus the selection length plus 1 is less than 32,767, the character code is passed to TEKey for insertion into the TextEdit structure. In addition, and because all this could change the number of lines in the TextEdit structure, the scroll bar adjustment function is called.

If the TextEdit limit will be exceeded by accepting the character, an alert is invoked advising the user of the situation.

The last line calls a function that prints data extracted from the edit text and control structures at the bottom of the window.

### **scrollActionFunction**

scrollActionFunction is associated with the vertical scroll bar. It is the callback function which will be repeatedly called by TrackControl when the kEventMouseDown event type is received. It will be called repeatedly while the mouse button remains down in the scroll box/scroller, scroll arrows or gray areas/track of the vertical scroll bar.

The first line gets a reference to the window object for the window which “owns” the control. The next two lines get a handle to the TextEdit structure associated with the window.

Within the outer if block, the first if block executes if the control part is not the scroll box/scroller (that is, the indicator). The purpose of the switch is to get a value into the variable linesToScroll. If the mouse-down was in a scroll arrow, that value will be 1. If the mouse-down was in a gray area/track, that value will be equivalent to one less than the number of text lines that will fit in the view rectangle. (Subtracting 1 from the total number of lines that will fit in the view rectangle ensures that the line of text at the bottom/top of the view rectangle prior to a gray area/track scroll will be visible at the top/bottom of the window after the scroll.)

Immediately after the switch, the value in linesToScroll is changed to a negative value if the mouse-down occurred in either the down scroll arrow or down gray area/track.

The next block ensures that no scrolling action will occur if the document is currently scrolled fully up (control value equals control maximum) or fully down (control value equals 0). In either case, linesToScroll will be set to 0, meaning that the call to TEScroll near the end of the function will not occur.

SetControlValue sets the control value to the value just previously calculated, that is, to the current control value minus the value in linesToScroll.

The next line sets the value in linesToScroll back to what it was before the line linesToScroll = controlvalue - linesToScroll executed. This value, multiplied by the value in the lineHeight field of the TextEdit structure, is later passed to TEScroll as the parameter which specifies the number of pixels to scroll.

If the control part is the scroll box/scroller (that is, the indicator), the variable `linesToScroll` is assigned a value equal to the control's value as it was the last time this function was called minus the control's current value. The global variable which holds the control's "old" value is then assigned the control's current value preparatory to the next call to this function.

With the number of lines to scroll determined, `TEScroll` is called to scroll the text within the view rectangle by the number of pixels specified in the second parameter. (Positive values scroll the text towards the bottom of the screen. Negative values scroll the text towards the top.)

The last line is for demonstration purposes only. It calls the function that prints data extracted from the edit and control structures at the bottom of the window.

### **doInContent**

`doInContent` is called when the `kEventWindowClickContentRgn` event type is received.

The first three lines retrieve a handle to the `TextEdit` structure associated with the front window. The call to `PtInRect` checks whether the mouse-down occurred within the view rectangle. (Note that the view rectangle is in local coordinates, so the mouse-down coordinates passed as the first parameter to the `PtInRect` call must also be in local coordinates.) If the mouse-down was in the view rectangle, `TEClick` is called to advise `TextEdit` of the mouse-down event. Note that the position of the shift key is passed in the second parameter. (`TEClick`'s behavior depends on the position of the shift key.)

### **doDrawContent**

`doDrawContent` is called when the `kEventWindowDrawContent` event type is received.

The first two lines get the handle to the `TextEdit` structure associated with the window.

`UpdateControls` is called to draw the scroll bar. The call to `TEUpdate` draws the text currently in the `TextEdit` structure.

### **doActivateDeactivate**

`doActivateDeactivate` performs window activation/deactivation. It is called when the `kEventWindowActivated` and `kEventWindowDeactivated` event types are received.

The first two lines retrieve a handle to the `TextEdit` structure for the window. If the window is becoming active, its graphics port is set as the current graphics port. The bottom of the view rectangle is then adjusted so that the height of the view rectangle is an exact multiple of the value in the `lineHeight` field of the `TextEdit` structure. (This avoids the possibility of only part of the full height of a line of text appearing at the bottom of the view rectangle.) `TEActivate` activates the `TextEdit` structure associated with the window, `ActivateControl` activates the scroll bar, `doAdjustScrollbar` adjusts the scroll bar, and `doAdjustCursor` adjusts the cursor shape.

If the window is becoming inactive, `TEDeactivate` deactivates the `TextEdit` structure associated with the window and `DeactivateControl` deactivates the scroll bar.

### **doNewDocWindow**

`doNewDocWindow` is called at program launch and when the user chooses New or Open from the File menu. It opens a new window, associates a document structure with that window, creates a vertical scroll bar, creates a monostyled `TextEdit` structure, installs the custom click loop (callback) function, enables automatic scrolling, and enables outline highlighting.

The call to `CreateNewWindow` and the following block creates a new window with the standard document window attributes less the size box/resize control. Note that the window's graphics port is set as the current port before the later call to `TENew`. (Because the `TextEdit` structure assumes the drawing environment specified in the graphics port structure, setting the graphics port must be done before `TENew` creates the `TextEdit` structure.)

The call to `TextSize` sets the text size. This, together with the default application font, will be copied from the graphics port to the `TextEdit` structure when `TENew` is called.

After the window event handler is installed, a document structure is created and the handle stored in the window's window object. The following line increments the global variable that keeps track of the number of open windows. `GetNewControl` creates a vertical scroll bar and assigns a handle to it to the appropriate field of the document structure. The next block establishes the view and destination rectangles two pixels inside the window's port rectangle less the scroll bar.

`MoveHHI` and `HLock` move the document structure high and lock it. A monostyled `TextEdit` structure is then created by `TENew` and its handle is assigned to the appropriate field of the document structure. (If this call is not successful, the window and scroll bar are disposed of, an error alert is displayed, and the function returns.) The handle to the document structure is then unlocked.

`TESetClickLoop` installs the universal procedure pointer to the custom click loop (callback) function `customClickLoop` in the `clickLoop` field of the `TextEdit` structure. `TEAutoView` enables automatic scrolling for the `TextEdit` structure. `TEFeatureFlag` enables outline highlighting for the `TextEdit` structure.

The last line returns a reference to the newly opened window's window object.

### **customClickLoop**

`customClickLoop` replaces the default click loop function so as to provide for scroll bar adjustment in concert with automatic scrolling. Following a mouse-down within the view rectangle, `customClickLoop` is called repeatedly by `TEClick` as long as the mouse button remains down.

The first three lines retrieve a handle to the `TextEdit` structure associated with the window. The next two lines save the current graphics port and set the window's graphics port as the current port.

The window's current clip region will have been set by `TextEdit` to be equivalent to the view rectangle. Since the scroll bar has to be redrawn, the clipping region must be temporarily reset to include the scroll bar. Accordingly, `GetClip` saves the current clipping region and the following two lines set the clipping region to the bounds of the coordinate plane.

`GetMouse` gets the current position of the cursor. If the cursor is above the top of the port rectangle, the text must be scrolled downward. Accordingly, the variable `linesToScroll` is set to 1. The subsidiary function `doSetScrollBarValue` is then called to, amongst other things, reset the scroll bar's value. Note that the value in `linesToScroll` may be modified by `doSetScrollBarValue`. If `linesToScroll` is not set to 0 by `doSetScrollBarValue`, `TEScroll` is called to scroll the text by a number of pixels equivalent to the value in the `lineHeight` field of the `TextEdit` structure, and in a downwards direction.

If the cursor is below the bottom of the port rectangle, the same process occurs except that the variable `linesToScroll` is set to -1, thus causing an upwards scroll of the text (assuming that the value in `linesToScroll` is not changed to 0 by `doSetScrollBarValue`).

If scrolling has occurred, `doDrawDataPanel` redraws the data panel. `SetClip` restores the clipping region to that established by the view rectangle and `SetPort` restores the saved graphics port. Finally, the last line returns true. (A return of false would cause `TextEdit` to stop calling `customClickLoop`, as if the user had released the mouse button.)

### **doSetScrollBarValue**

`doSetScrollBarValue` is called from `customClickLoop`. Apart from setting the scroll bar's value so as to cause the scroll box to follow up automatic scrolling, the function checks whether the limits of scrolling have been reached.

The first two lines get the current control value and the current control maximum value. At the next block, the value in the variable `linesToScroll` will be set to either 0 (if the current control value is 0) or equivalent to the control maximum value (if the current control value is equivalent to the control maximum value). If these modifications do not occur, the value in `linesToScroll` will remain as established at the first line in this block—that is, the current control value minus the value in `linesToScroll` as passed to the function.

`SetControlValue` sets the control's value to the value in `linesToScroll`. The last line sets the value in `linesToScroll` to 0 if the limits of scrolling have already been reached, or to the value as it was when the `doSetScrollBarValue` function was entered.



## doAdjustMenus

doAdjustMenus adjusts the menus. Much depends on whether any windows are currently open.

If at least one window is open, the first three lines in the if block get a handle to the TextEdit structure associated with the front window and the first call to EnableMenuItem enables the Close item in the File menu. If there is a current selection range, the Cut, Copy, and Clear items are enabled, otherwise they are disabled. If there is data of flavor type 'TEXT' in the scrap (the call to GetScrapFlavorFlags), the Paste item is enabled, otherwise it is disabled. If there is any text in the TextEdit structure, the SaveAs and Select All items are enabled, otherwise they are disabled.

If no windows are open, the Close, SaveAs, Clear, and Select All items are disabled.

## doMenuChoice

If the MonoTextEdit Help item in the Mac OS 8/9 Apple menu or Mac OS X Help menu is chosen, the function doHelp is called.

## doFileMenu

doFileMenu handles File menu choices, calling the appropriate functions according to the menu item chosen. In the SaveAs case, a handle to the TextEdit structure associated with the front window is retrieved and passed as a parameter to the function doSaveAsFile.

Note that, because TextEdit, rather than file operations, is the real focus of this program, the file-related code has been kept to a minimum, even to the extent of having no Save-related, as opposed to SaveAs-related, code.

## doEditMenu

doEditMenu handles choices from the Edit menu. Recall that, in the case of monostyled TextEdit structures, TECut, TEOCopy, and TEPaste do not copy/paste text to/from the scrap. This program, however, supports copying/pasting to/from the scrap.

Before the usual switch is entered, a handle to the TextEdit structure associated with the front window is retrieved.

The iCut case handles the Cut command. Firstly, the call to ClearCurrentScrap attempts to clear the scrap. If the call succeeds, PurgeSpace establishes the size of the largest block in the heap that would be available if a general purge were to occur. The next line gets the current selection length. If the selection length is greater than the available memory, the user is advised via an error message. Otherwise, TECut is called to remove the selected text from the TextEdit structure and copy it to the TextEdit private scrap. The scroll bar is adjusted, and TEToScrap is called to copy the private scrap to the scrap. If the TEToScrap call is not successful, ClearCurrentScrap cleans up as best it can by emptying the scrap.

The `iCopy` case handles the Copy command. If the call to `ClearCurrentScrap` to empty the scrap is successful, `TECopy` is called to copy the selected text from the `TextEdit` structure to the `TextEdit` private scrap. `TEToScrap` then copies the private scrap to the scrap. If the `TEToScrap` call is not successful, `ClearCurrentScrap` cleans up as best it can by emptying the scrap.

The `iPaste` case handles the Paste command, which must not proceed if the paste would cause the `TextEdit` limit of 32,767 bytes to be exceeded. The third line establishes a value equal to the number of bytes in the `TextEdit` structure plus the number of bytes of the 'TEXT' flavor type in the scrap. If this value exceeds the `TextEdit` limit, the user is advised via an error message. Otherwise, `TEFromScrap` copies the scrap to `TextEdit`'s private scrap, `TEPaste` inserts the private scrap into the `TextEdit` structure, and the following line adjusts the scroll bar.

The `iClear` case handles the Clear command. `TEDelete` deletes the current selection range from the `TextEdit` structure and the following line adjusts the scroll bar.

The `iSelectAll` case handle the Select All command. `TESetSelect` sets the selection range according to the first two parameters (`selStart` and `selEnd`).

### **doGetSelectLength**

`doGetSelectLength` returns a value equal to the length of the current selection.

### **doAdjustScrollbar**

`doAdjustScrollbar` adjusts the vertical scroll bar.

The first two lines retrieve handles to the document structure and `TextEdit` structure associated with the window in question.

At the next block, the value in the `nLines` field of the `TextEdit` structure is assigned to the `numberOfLines` variable. The next action is somewhat of a refinement and is therefore not essential. If the last character in the `TextEdit` structure is the return character, `numberOfLines` is incremented by one. This will ensure that, when the document is scrolled to its end, a single blank line will appear below the last line of text.

At the next block, the variable `controlMax` is assigned a value equal to the number of lines in the `TextEdit` structure less the number of lines that will fit in the view rectangle. If this value is less than 0 (indicating that the number of lines in the `TextEdit` structure is less than the number of lines that will fit in the view rectangle), `controlMax` is set to 0. `SetControlMaximum` then sets the control maximum value. If `controlMax` is 0, the scroll bar is automatically unhighlighted by the `SetControlMaximum` call.

The first line of the next block assigns to the variable `controlValue` a value equal to the number of text lines that the top of the destination rectangle is currently “above” the top of the view rectangle. If the calculation returns a value less than 0 (that is, the document has been scrolled fully down), `controlValue` is set to 0. If the calculation returns a value greater than the current control maximum value (that is, the document has been scrolled fully up), `controlValue` is set to equal that value. `SetControlValue` sets the control value to the value in `controlValue`. For example, if the top of the view rectangle is 2, the top of the destination rectangle is -34 and the `lineHeight` field of the `TextEdit` structure contains the value 13, the control value will be set to 3.

`SetControlViewSize` is called to advise the Control Manager of the height of the view rectangle. This will cause the scroll box/scroller to be a proportional scroll box/scroller. (On Mac OS 8/9, this assumes that the user has selected Smart Scrolling on in the Appearance control panel.)

With the control maximum value and the control value set, `TEScroll` is called to make sure the text is scrolled to the position indicated by the scroll box/scroller. Extending the example in the previous paragraph, the second parameter in the `TEScroll` call is  $2 - (34 - (3 * 13))$ , that is, 0. In that case, no corrective scrolling actually occurs.

### **doAdjustCursor**

`doAdjustCursor` is called when the `kEventMouseMoved`, and `kEventWindowActivated` event types are received. It adjusts the cursor to the I-Beam shape when the cursor is over the content region less the scroll bar area, and to the arrow shape when the cursor is outside that region. It is similar to the cursor adjustment function in the demonstration program `GworldPicCursIcon` (Chapter 13).

### **doCloseWindow**

`doCloseWindow` is called when the `kEventWindowClose` event type is received and when the user chooses Close from the File menu. It disposes of the specified window. The associated scroll bar, the associated `TextEdit` structure and the associated document structure are disposed of before the call to `DisposeWindow`.

### **doSaveAsFile, doOpenCommand, doOpenFile**

The functions `doSaveAsFile`, `doOpenCommand`, and `doOpenFile` are document saving and opening functions, enabling the user to open and save “TEXT” documents. Since the real focus of this program is `TextEdit`, not file operations, the code is “bare bones” and as brief as possible, Navigation Services 2.0 functions being used rather than the Navigation Services 3.0 functions used in the demonstration program `Files` (see Chapter 18).



For a complete example of opening and saving monostyled 'TEXT' documents, see the demonstration program at Files (see Chapter 18).

### **doDrawDataPanel**

`doDrawDataPanel` draws the data panel at the bottom of each window. Displayed in this panel are the values in the `teLength`, `nLines`, `lineHeight` and `destRect.top` fields of the `TextEdit` structure and the `ctrlValue` and `ctrlMax` fields of the scroll bar's control structure.

## **HelpDialog.c**

### **defines**

Constants are established for the index of error strings within a 'STR#' resource and 'TEXT', 'styl', and 'PICT' resource IDs. `kTextInset` which will be used to inset the view and destination rectangles a few pixels inside a user pane's rectangle.

### **typedef**

The first two data types are for a picture information structure and a document structure. (Note that one field in the document structure is a pointer to a picture information structure.) The third data type will be used for saving and restoring the background color and pattern.

### **doHelp**

`doHelp` is called when the user chooses the `MonoTextEdit` Help item in the Help menu.

The dialog will utilize a window event handler, a user pane drawing (callback) function, and a control action (callback) function. The first block creates the associated universal procedure pointers.

The call to `CreateNewWindow` creates a new window of the movable modal class. `NewHandle` creates a block for a document structure and the handle is stored in the window object.

The next block creates the dialog's controls and assigns an ID to each. In the case of the user pane control, `SetControlData` is called to set a user pane drawing function. In the case of the scroll bar, the control reference is assigned to the appropriate field of the dialog's document structure.

At the next block, the destination and view rectangles are both made equal to the user pane's rectangle, but inset four pixels from the left and right and two pixels from the top and bottom. The call to `TEStyleNew` creates a multistyled `TextEdit` structure based on those two rectangles.

A pointer to a picture information structure will eventually be assigned to a field in the document structure. For the moment, that field is set to `NULL`.

At the next block, two global variables are assigned the resource IDs relating to the first Help topic's 'TEXT'/'styl' resource and associated 'PICT' resources.

The next block calls the function `doGetText` that loads the specified 'TEXT'/'styl' resources and inserts the text and style information into the `TextEdit` structure.

The next block calls the function `doGetPictureInfo` that searches for option-space characters in the 'TEXT' resource and, if option-space characters are found, loads a like number of 'PICT' resources beginning with the specified ID.

`NewRgn` creates an empty region, which will be used to save the dialog's graphic's port's clipping region.

To complete the initial setting up, `ShowWindow` is called to make the dialog visible, following which `RunAppModalLoopForWindow` is called to run the nodal loop.

### **helpWindowEventHandler**

`helpWindowEventHandler` is the event handler for the dialog. It responds to mouse clicks in the dialog's three controls.

If the push button was clicked, `QuitAppModalLoopForWindow` is called to terminate the modal loop and restore menu activation/deactivation status to that which obtained prior to the call to `RunAppModalLoopForWindow`, and the dialog is closed down.

Note that if the click was in the scroll bar, `TrackControl` is called with a universal procedure pointer to an application-defined action (callback) function is passed in the `actionProc` parameter.

If the click was in the pop-up menu button, the menu item chosen is determined, and the switch assigns the appropriate 'TEXT'/'styl' and 'PICT' resource IDs to the global variables which keep track of which of those resources are to be loaded and displayed.

The next three lines get the view rectangle from the `TextEdit` structure, allowing the next blocks to perform the same "get text" and "get picture information" actions as were preformed at startup, but this time with the 'TEXT'/'styl' and 'PICT' resources as determined within the preceding switch.

The call to `doDrawPictures` draws any pictures that might initially be located in the view rectangle.

### **userPaneDrawFunction**

`userPaneDrawFunction` is the user pane drawing function set within `doHelp`.

The first line gets a reference to the user pane control's owning window. The next three lines get the user pane's rectangle, insets that rectangle by one pixel all round, and then further

expands it to the right edge of the scroll bar. At the next block, a list box frame is drawn in the appropriate state, depending on whether the the movable modal dialog is currently the active window.

The next block erases the previously defined rectangle with the white color using the white pattern.

The next three lines retrieve the view rectangle from the `TextEdit` structure. The call to `TEUpdate` draws the text in the `TextEdit` structure in the view rectangle. The call to `doDrawPictures` draws any pictures that might currently be located in the view rectangle.

### **doGetText**

`doGetText` is called when the dialog is first opened and when the user chooses a new item from the pop-up menu. It loads the 'TEXT'/'styl' resources associated with the current menu item and inserts the text and style information into the `TextEdit` structure.

The first two lines get a handle to the `TextEdit` structure. The next two lines set the selection range to the maximum value and then delete that selection. The destination rectangle is then made equal to the view rectangle and the scroll bar's value is set to 0.

`GetResource` is called twice to load the specified 'TEXT'/'styl' resources, following which `TEStyleInsert` is called to insert the text and style information into the `TextEdit` structure. Two calls to `ReleaseResource` then release the 'TEXT'/'styl' resources.

The next block gets the total height of the text in pixels.

At the next block, if the height of the text is greater than the height of the view rectangle, the local variable `heightToScroll` is made equal to the total height of the text minus the height of the view rectangle. This value is then used to set the scroll bar's maximum value. The scroll bar is then made active.

`SetControlViewSize` is called to advise the Control Manager of the height of the view rectangle. This will cause the scroll box to be a proportional scroll box.

If the height of the text is less than the height of the view rectangle, the scroll bar is made inactive.

`true` is returned if the `GetResource` calls did not return with `false`.

### **doGetPictureInfo**

`doGetPictureInfo` is called after `getText` when the dialog is opened and when the user chooses a new item from the pop-up menu. It searches for option-space characters in the 'TEXT' resource and, if option-space characters are found, loads a like number of 'PICT' resources beginning with the specified ID.

The first line gets a handle to the dialog's document structure.

If the `picInfoRecPtr` field of the document structure does not contain `NULL`, the currently loaded 'PICT' resources are released, the picture information structures are disposed of, and the `picInfoRecPtr` field of the document structure is set to `NULL`.

The next line sets to 0 the field of the document structure which keeps track of the number of pictures associated with the current 'TEXT' resource.

The next two lines get a handle to the `TextEdit` structure, then a handle to the block containing the actual text. This latter is then used to assign the size of that block to a local variable. After two local variables are initialized, the block containing the text is locked.

The next block counts the number of option-space characters in the text block. At the following block, if there are no option-space characters in the block, the block is unlocked and the function returns.

A call to `NewPtr` then allocates a nonrelocatable block large enough to accommodate a number of picture information structures equal to the number of option-space characters found. The pointer to the block is then assigned to the appropriate field of the dialog's document structure.

The next line resets the offset value to 0.

The for loop repeats for each of the option-space characters found. `GetPicture` loads the specified 'PICT' resource (the resource ID being incremented from the base ID at each pass through the loop) and assigns the handle to the appropriate field of the relevant picture information structure. `Munger` finds the offset to the next option-space character and `TEGetPoint` gets the point, based on the destination rectangle, of the bottom left of the character at that offset. `TEGetStyle` is called to obtain the line height of the character at the offset and this value is subtracted from the value in the point's `v` field. The offset is incremented and the rectangle in the picture structure's `picFrame` field is assigned to the bounds field of the picture information structure. The next block then offsets this rectangle so that it is centered laterally in the destination rectangle with its top offset from the top of the destination rectangle by the amount established at the line `picturePoint.v -= lineHeight;`

The third last line assigns the number of pictures loaded to the appropriate field of the dialog's document structure. The block containing the text is then unlocked. The function returns true if false has not previously been returned within the for loop.

### actionFunction

`actionFunction` is the action function called from within the event filter (callback) function `eventFilter`. It is repeatedly called by `TrackControl` while the mouse button remains down within the scroll bar. Its ultimate purpose is to determine the new scrollbar value when the

mouse-down is within the scroll arrows or gray areas/track of the scroll bar, and then call a separate function to effect the actual scrolling of the text and pictures based on the new scrollbar value. (The scroll bar is the live scrolling variant, so the CEDF automatically updates the control's value while the mouse remains down in the scroll box/scroller.)

If the cursor is still not within the control, execution falls through to the bottom of the function and the action function exits.

The first block gets a pointer to the owner of the scrollbar, retrieves a handle to the dialog's document structure, gets a handle to the TextEdit structure, gets the view rectangle, and assigns a value to the h field of a point variable equal to the left of the view rectangle plus 4 pixels.

The switch executes only if the mouse-down is not in the scroll box.

In the case of the Up scroll arrow, the variable delta is assigned a value which will ensure that, after the scroll, the top of the incoming line of text will be positioned cleanly at top of the view rectangle.

In the case of the Down scroll arrow, the variable delta is assigned a value which will ensure that, after the scroll, the bottom of the incoming line of text will be positioned cleanly at bottom of the view rectangle.

In the case of the Up gray area/track, the variable delta is assigned a value which will ensure that, after the scroll, the top of the top line of text will be positioned cleanly at the top of the view rectangle and the line of text which was previously at the top will still be visible at the bottom of the view rectangle.

In the case of the Down gray area/track, the variable delta is assigned a value which will ensure that, after the scroll, the bottom of the bottom line of text will be positioned cleanly at the bottom of the view rectangle and the line of text which was previously at the bottom will still be visible at the top of the view rectangle.

The first line after the switch gets the pre-scroll scroll bar value. If the text is not fully scrolled up and a scroll up is called for, or if the text is not fully scrolled down and a scroll down is called for, the current clipping region is saved, the clipping region is set to the dialog's port rectangle, the scroll bar value is set to the required new value, and the saved clipping region is restored. (TextEdit may have set the clipping region to the view rectangle, so it must be changed to include the scroll bar area, otherwise the scroll bar will not be drawn.)

With the scroll bar's new value set and the scroll box redrawn in its new position, the function for scrolling the text and pictures is called. Note that this last line will also be called if the mouse-down was within the scroll box.



## doScrollTextAndPicts

`doScrollTextAndPicts` is called from `actionFunction`. It scrolls the text within the view rectangle and calls another function to draw any picture whose rectangle intersects the “vacated” area of the view rectangle.

The first line sets the background color to white and the background pattern to white.

The next two lines get a handle to the `TextEdit` structure. The next line determines the difference between the top of the destination rectangle and the top of the view rectangle and the next subtracts from this value the scroll bar’s new value. If the result is zero, the text must be fully scrolled in one direction or the other, so the function simply returns.

If the text is not already fully scrolled one way or the other, `TEScroll` scrolls the text in the view rectangle by the number of pixels determined at the fifth line.

If there are no pictures associated with the ‘TEXT’ resource in use, the function returns immediately after the text is scrolled.

The next consideration is the pictures and whether any of their rectangles, as stored in the picture information structure, intersect the area of the view rectangle “vacated” by the scroll. At the if/else block, a rectangle is made equal to the “vacated” area of the view rectangle, the if block catering for the scrolling up case and the else block catering for the scrolling down case. This rectangle is passed as a parameter in the call to `drawPictures`.

## doDrawPictures

`doDrawPictures` determines whether any pictures intersect the rectangle passed to it as a formal parameter and draws any pictures that do.

The first two lines get handles to the dialog’s document structure and the `TextEdit` structure.

The next line determines the difference between the top of the destination rectangle and the top of the view rectangle. This will be used later to offset the picture’s rectangle from destination rectangle coordinates to view rectangle coordinates. The next line determines the number of pictures associated with the current ‘TEXT’ resource, a value which will be used to control the number of passes through the following for loop.

Within the loop, the picture’s rectangle is retrieved from the picture information structure and offset to the coordinates of the view rectangle. `SectRect` determines whether this rectangle intersects the rectangle passed to `drawPictures` from `scrollTextAndPicts`. If it does not, the loop returns for the next iteration. If it does, the picture’s handle is retrieved, `LoadResource` checks whether the ‘PICT’ resource is in memory and, if necessary, loads it, `HLock` locks the handle, `DrawPicture` draws the picture, and `HUnlock` unlocks the handle. Before `DrawPicture` is called, the clipping region is temporarily adjusted to equate to the rectangle passed to `drawPictures` from `scrollTextAndPicts` so as to limit drawing to that rectangle.

### doCloseHelp

doCloseHelp closes down the Help dialog.

The first two lines retrieve a handle to the dialog's document structure. The next two lines dispose of the region used to save the clipping region. TEDispose disposes of the TextEdit structure. The next block disposes of any 'PICT' resources currently in memory, together with the picture information structure. Finally, the window's document structure is disposed of, the window itself is disposed of, and the graphics port saved in doHelp is set as the current port.

### doSetBackgroundWhite

doSetBackgroundWhite sets the background color to white and the background pattern to the pattern white.

## Demonstration Program DateTimeNumbers Listing

```
// *****
// DateTimeNumbers.c                                CARBON EVENT MODEL
// *****
//
// This program, which opens a single modeless dialog, demonstrates the formatting and display
// of dates, times and numbers.
//
// The program utilises the following resources:
//
// · A 'plst' resource.
//
// · An 'MBAR' resource, and 'MENU' resources for Apple/Application, File, and Edit menus
//   (preload, non-purgeable).
//
// · A 'DLOG' resource and associated 'dlgx', 'DITL', 'dfnt', and 'CNTL' resources
//   (purgeable).
//
// · 'hdlg' and 'STR#' resources (purgeable) for balloon help and help tags.
//
// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****

// ..... includes

#include <Carbon.h>
#include <string.h>

// ..... defines

#define rMenumbar          128
#define mAppleApplication 128
#define iAbout             1
#define mFile              129
```

```

#define iQuit                12
#define mEdit                130
#define iCut                 3
#define iCopy                4
#define iPaste               5
#define iClear               6
#define rDialog              128
#define iStaticTextTodaysDate 2
#define iStaticTextCurrentTime 4
#define iEditTextTitle       10
#define iEditTextQuantity    11
#define iEditTextValue       12
#define iEditTextDate        13
#define iButtonEnter         18
#define iButtonClear         19
#define iStaticTextTitle     26
#define iStaticTextQuantity  27
#define iStaticTextUnitValue  28
#define iStaticTextTotalValue 29
#define iStaticTextDate      30
#define kReturn              0x0D
#define kEnter               0x03
#define kLeftArrow           0x1C
#define kRightArrow          0x1D
#define kUpArrow             0x1E
#define kDownArrow           0x1F
#define kBackspace           0x08
#define kDelete              0x7F
#define topLeft(r)            (((Point *) &(r))[0])
#define botRight(r)           (((Point *) &(r))[1])

// ..... global variables

Boolean      gRunningOnX = false;
DialogRef    gDialogRef;
DateCacheRecord gDateCacheRec;
Boolean      gInBackground;

// ..... function prototypes

void          main                (void);
void          doPreliminaries     (void);
OSStatus      appEventHandler     (EventHandlerCallRef,EventRef,void *);
OSStatus      windowEventHandler  (EventHandlerCallRef,EventRef,void *);
void          doIdle              (void);
void          doMenuChoice        (MenuID,MenuItemIndex);
void          doCopyPString       (Str255,Str255);
void          doTodaysDate        (void);
void          doAcceptNewRecord   (void);
void          doUnitAndTotalValue (Str255,Str255);
void          doDate              (Str255);
void          doAdjustCursor      (WindowRef);
void          doClearAllFields    (void);
ControlKeyFilterResult numericFilter (ControlRef,SInt16 *,SInt16 *,EventModifiers *);
void          helpTags           (void);

```



```
// ***** main

void main(void)
{
    MenuBarHandle      menubarHdl;
    SInt32              response;
    MenuRef             menuRef;
    ControlKeyFilterUPP numericFilterUPP;
    ControlRef          controlRef;
    EventTypeSpec       applicationEvents[] = { { kEventClassApplication, kEventAppActivated },
                                                { kEventClassCommand, kEventProcessCommand },
                                                { kEventClassMouse, kEventMouseMoved } };
    EventTypeSpec       windowEvents[] = { { kEventClassWindow, kEventWindowDrawContent },
                                            { kEventClassWindow, kEventWindowActivated },
                                            { kEventClassWindow, kEventWindowClose },
                                            { kEventClassMouse, kEventMouseDown },
                                            { kEventClassKeyboard, kEventRawKeyDown } };

    // ..... do preliminaries

    doPreliminaries();

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMenuBar);
    if(menubarHdl == NULL)
        ExitToShell();
    SetMenuBar(menubarHdl);
    DrawMenuBar();

    Gestalt(gestaltMenuMgrAttr,&response);
    if(response & gestaltMenuMgrAquaLayoutMask)
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
        {
            DeleteMenuItem(menuRef,iQuit);
            DeleteMenuItem(menuRef,iQuit - 1);
            DisableMenuItem(menuRef,0);
        }

        gRunningOnX = true;
    }
    else
    {
        menuRef = GetMenuRef(mFile);
        if(menuRef != NULL)
            SetMenuItemCommandID(menuRef,iQuit,kHICCommandQuit);
    }

    // ..... install application event handler and a timer

    InstallApplicationEventHandler(NewEventHandlerUPP((EventHandlerProcPtr) appEventHandler),
                                GetEventTypeCount(applicationEvents),applicationEvents,
                                0,NULL);
}
```

```

InstallEventLoopTimer(GetCurrentEventLoop(),0,TicksToEventTime(GetCaretTime()),
                      NewEventLoopTimerUPP((EventLoopTimerProcPtr) doIdle),NULL,NULL);

// ..... open modeless dialog, change attributes, and install handler

if(!(gDialogRef = GetNewDialog(rDialog,NULL,(WindowRef) -1)))
    ExitToShell();

ChangeWindowAttributes(GetDialogWindow(gDialogRef),kWindowStandardHandlerAttribute |
                      kWindowCloseBoxAttribute,
                      kWindowCollapseBoxAttribute);

InstallWindowEventHandler(GetDialogWindow(gDialogRef),
                          NewEventHandlerUPP((EventHandlerProcPtr) windowEventHandler),
                          GetEventTypeCount(windowEvents),windowEvents,0,NULL);

// ..... create universal procedure pointers for key filter, attach to two edit text controls

numericFilterUPP = NewControlKeyFilterUPP((ControlKeyFilterProcPtr) numericFilter);

GetDialogItemAsControl(gDialogRef,iEditTextQuantity,&controlRef);
SetControlData(controlRef,kControlEntireControl,kControlEditTextKeyFilterTag,
               sizeof(numericFilterUPP),&numericFilterUPP);

GetDialogItemAsControl(gDialogRef,iEditTextValue,&controlRef);
SetControlData(controlRef,kControlEntireControl,kControlEditTextKeyFilterTag,
               sizeof(numericFilterUPP),&numericFilterUPP);

// ..... set help tags, get and display today's date and show window

if(gRunningOnX)
    helpTags();

doTodaysDate();

ShowWindow(GetDialogWindow(gDialogRef));

// ..... display today's date and initialise date cache structure

InitDateCache(&gDateCacheRec);

// ..... run application event loop

RunApplicationEventLoop();
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(64);
    InitCursor();
}

```

```
// ***** appEventHandler

OSStatus appEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                        void * userData)
{
    OSStatus      result = eventNotHandledErr;
    UInt32        eventClass;
    UInt32        eventKind;
    HICCommand     hiCommand;
    MenuID         menuID;
    MenuItemIndex  menuItem;

    eventClass = GetEventClass(eventRef);
    eventKind  = GetEventKind(eventRef);

    switch(eventClass)
    {
        case kEventClassApplication:
            if(eventKind == kEventAppActivated)
                SetThemeCursor(kThemeArrowCursor);
            break;

        case kEventClassCommand:
            if(eventKind == kEventProcessCommand)
            {
                GetEventParameter(eventRef, kEventParamDirectObject, typeHICCommand, NULL,
                                sizeof(HICCommand), NULL, &hiCommand);
                menuID = GetMenuID(hiCommand.menu.menuRef);
                menuItem = hiCommand.menu.menuItemIndex;
                if((hiCommand.commandID != kHICCommandQuit) &&
                    (menuID >= mAppleApplication && menuID <= mEdit))
                {
                    doMenuChoice(menuID, menuItem);
                    result = noErr;
                }
            }
            break;

        case kEventClassMouse:
            if(eventKind == kEventMouseMoved)
            {
                doAdjustCursor(GetDialogWindow(gDialogRef));
                result = noErr;
            }
            break;
    }

    return result;
}
```

```
// ***** windowEventHandler

OSStatus windowEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                           void* userData)
{
    OSStatus    result = eventNotHandledErr;
    UInt32      eventClass;
    UInt32      eventKind;
    EventRecord  eventRecord;
    SInt16      itemHit;
    SInt8        charCode;
    ControlRef   controlRef;
    UInt32      finalTicks;

    eventClass = GetEventClass(eventRef);
    eventKind = GetEventKind(eventRef);

    switch(eventClass)
    {
        case kEventClassWindow: // event class window
            ConvertEventRefToEventRecord(eventRef, &eventRecord);
            switch(eventKind)
            {
                case kEventWindowActivated:
                    DialogSelect(&eventRecord, &gDialogRef, &itemHit);
                    result = noErr;
                    break;

                case kEventWindowClose:
                    QuitApplicationEventLoop();
                    result = noErr;
                    break;
            }

        case kEventClassMouse: // event class mouse
            ConvertEventRefToEventRecord(eventRef, &eventRecord);
            switch(eventKind)
            {
                case kEventMouseDown:
                    if(IsDialogEvent(&eventRecord))
                    {
                        if(DialogSelect(&eventRecord, &gDialogRef, &itemHit))
                        {
                            if(itemHit == iButtonEnter)
                            {
                                doAcceptNewRecord();
                                doClearAllFields();
                            }
                            else if(itemHit == iButtonClear)
                                doClearAllFields();
                        }
                    }
                    doAdjustCursor(GetDialogWindow(gDialogRef));
                    break;
            }
            break;
    }
}
```

```

    case kEventClassKeyboard: // event class keyboard
    {
        switch(eventKind)
        {
            case kEventRawKeyDown:
                ConvertEventRefToEventRecord(eventRef,&eventRecord);
                GetEventParameter(eventRef,kEventParamKeyMacCharCodes,typeChar,NULL,
                                sizeof(charCode),NULL,&charCode);
                if((charCode == kReturn) || (charCode == kEnter))
                {
                    GetDialogItemAsControl(gDialogRef,iButtonEnter,&controlRef);
                    HiliteControl(controlRef,kControlButtonPart);
                    Delay(8,&finalTicks);
                    HiliteControl(controlRef,kControlEntireControl);
                    doAcceptNewRecord();
                    doClearAllFields();
                    return noErr;
                }
                break;
        }
        break;
    }

    return result;
}

// ***** doIdle

void doIdle(void)
{
    UInt32      rawSeconds;
    static UInt32 oldRawSeconds;
    Str255      timeString;
    ControlRef   controlRef;

    if(gRunningOnX)
        IdleControls(GetDialogWindow(gDialogRef));

    GetDateTime(&rawSeconds);

    if(rawSeconds > oldRawSeconds)
    {
        TimeString(rawSeconds,true,timeString,NULL);

        GetDialogItemAsControl(gDialogRef,iStaticTextCurrentTime,&controlRef);
        SetControlData(controlRef,kControlEntireControl,kControlStaticTextTextTag,timeString[0],
                        &timeString[1]);
        Draw1Control(controlRef);

        oldRawSeconds = rawSeconds;
    }
}

```

```
// ***** doMenuChoice

void doMenuChoice(MenuID menuID,MenuItemIndex menuItem)
{
    if(menuID == 0)
        return;

    switch(menuID)
    {
        case mAppleApplication:
            if(menuItem == iAbout)
                SysBeep(10);
            break;

        case mEdit:
            switch(menuItem)
            {
                case iCut:
                    DialogCut(gDialogRef);
                    break;

                case iCopy:
                    DialogCopy(gDialogRef);
                    break;

                case iPaste:
                    DialogPaste(gDialogRef);
                    break;

                case iClear:
                    DialogDelete(gDialogRef);
                    break;
            }
            break;
    }
}

// ***** doCopyPString

void doCopyPString(Str255 sourceString,Str255 destinationString)
{
    SInt16 stringLength;

    stringLength = sourceString[0];
    BlockMove(sourceString + 1,destinationString + 1,stringLength);
    destinationString[0] = stringLength;
}

// ***** doTodaysDate

void doTodaysDate(void)
{
    UInt32    rawSeconds;
    Str255    dateString;
    ControlRef controlRef;
```

```

    GetDateTime(&rawSeconds);
    DateString(rawSeconds, longDate, dateString, NULL);

    GetDlgItemAsControl(gDialogRef, iStaticTextTodaysDate, &controlRef);
    SetControlData(controlRef, kControlEntireControl, kControlStaticTextTextTag, dateString[0],
        &dateString[1]);
}

// ***** doAcceptNewRecord

void doAcceptNewRecord(void)
{
    SInt16    theType;
    Handle    theHandle;
    Rect      theRect;
    Str255    titleString, quantityString, valueString, dateString;
    ControlRef controlRef;

    GetDlgItem(gDialogRef, iEditTextTitle, &theType, &theHandle, &theRect);
    GetDlgItemText(theHandle, titleString);

    GetDlgItem(gDialogRef, iEditTextQuantity, &theType, &theHandle, &theRect);
    GetDlgItemText(theHandle, quantityString);

    GetDlgItem(gDialogRef, iEditTextValue, &theType, &theHandle, &theRect);
    GetDlgItemText(theHandle, valueString);

    GetDlgItem(gDialogRef, iEditTextDate, &theType, &theHandle, &theRect);
    GetDlgItemText(theHandle, dateString);

    if(titleString[0] == 0 || quantityString[0] == 0 || valueString[0] == 0 ||
        dateString[0] == 0)
    {
        SysBeep(10);
        return;
    }

    GetDlgItemAsControl(gDialogRef, iStaticTextTitle, &controlRef);
    SetControlData(controlRef, kControlEntireControl, kControlStaticTextTextTag, titleString[0],
        &titleString[1]);
    Draw1Control(controlRef);

    GetDlgItemAsControl(gDialogRef, iStaticTextQuantity, &controlRef);
    SetControlData(controlRef, kControlEntireControl, kControlStaticTextTextTag, quantityString[0],
        &quantityString[1]);
    Draw1Control(controlRef);

    doUnitAndTotalValue(valueString, quantityString);

    doDate(dateString);
}

```

```
// ***** doUnitAndTotalValue
```

```
void doUnitAndTotalValue(Str255 valueString, Str255 quantityString)
{
    Handle          itl4ResourceHdl;
    SInt32          numpartsOffset;
    SInt32          numpartsLength;
    NumberParts     *numpartsTablePtr;
    Str255          formatString = "\p'$'###,###,###.00;'Valueless';'Valueless'";
    NumFormatString formatStringRec;
    Str255          formattedNumString;
    extended80      value80Bit;
    SInt32          quantity;
    double          valueDouble;
    FormatResultType result;
    ControlRef       controlRef;

    GetIntlResourceTable(smSystemScript, iuNumberPartsTable, &itl4ResourceHdl, &numpartsOffset,
                        &numpartsLength);
    numpartsTablePtr = (NumberPartsPtr) ((SInt32) *itl4ResourceHdl + numpartsOffset);

    StringToFormatRec(formatString, numpartsTablePtr, &formatStringRec);

    StringToExtended(valueString, &formatStringRec, numpartsTablePtr, &value80Bit);
    ExtendedToString(&value80Bit, &formatStringRec, numpartsTablePtr, formattedNumString);

    GetDialogItemAsControl(gDialogRef, iStaticTextUnitValue, &controlRef);
    SetControlData(controlRef, kControlEntireControl, kControlStaticTextTextTag,
                  formattedNumString[0], &formattedNumString[1]);
    Draw1Control(controlRef);

    StringToNum(quantityString, &quantity);

    valueDouble = x80tod(&value80Bit);
    valueDouble = valueDouble * quantity;
    dtox80(&valueDouble, &value80Bit);

    result = ExtendedToString(&value80Bit, &formatStringRec, numpartsTablePtr,
                            formattedNumString);

    if(result == fFormatOverflow)
        doCopyPString("\p(Too large to display)", formattedNumString);

    GetDialogItemAsControl(gDialogRef, iStaticTextTotalValue, &controlRef);
    SetControlData(controlRef, kControlEntireControl, kControlStaticTextTextTag,
                  formattedNumString[0], &formattedNumString[1]);
    Draw1Control(controlRef);
}
```



```
// ***** doDate

void doDate(Str255 dateString)
{
    SInt32      lengthUsed;
    LongDateRec longDateTimeRec;
    LongDateTime longDateTimeValue;
    ControlRef   controlRef;

    longDateTimeRec.ld.hour = 0;
    longDateTimeRec.ld.minute = 0;
    longDateTimeRec.ld.second = 0;

    StringToDate((Ptr) dateString + 1, dateString[0], &gDateCacheRec, &lengthUsed,
                  &longDateTimeRec);

    LongDateToSeconds(&longDateTimeRec, &longDateTimeValue);
    LongDateString(&longDateTimeValue, longDate, dateString, NULL);

    GetDlgItemAsControl(gDialogRef, iStaticTextDate, &controlRef);
    SetControlData(controlRef, kControlEntireControl, kControlStaticTextTextTag, dateString[0],
                   &dateString[1]);
    Draw1Control(controlRef);
}

// ***** doAdjustCursor

void doAdjustCursor(WindowRef windowRef)
{
    GrafPtr      oldPort;
    RgnHandle     arrowRegion, iBeamRegion;
    ControlRef    controlRef;
    Rect          iBeamRect;
    Point         mouseLocation;

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    arrowRegion = NewRgn();
    iBeamRegion = NewRgn();

    SetRectRgn(arrowRegion, -32768, -32768, 32767, 32767);

    GetKeyboardFocus(windowRef, &controlRef);
    GetControlBounds(controlRef, &iBeamRect);

    LocalToGlobal(&topLeft(iBeamRect));
    LocalToGlobal(&botRight(iBeamRect));

    RectRgn(iBeamRegion, &iBeamRect);
    DiffRgn(arrowRegion, iBeamRegion, arrowRegion);

    GetMouse(&mouseLocation);
    LocalToGlobal(&mouseLocation);
}
```

```

if(PtInRgn(mouseLocation,iBeamRegion))
    SetThemeCursor(kThemeIBeamCursor);
else
    SetThemeCursor(kThemeArrowCursor);

DisposeRgn(arrowRegion);
DisposeRgn(iBeamRegion);

SetPort(oldPort);
}

// ***** doClearAllFields

void doClearAllFields(void)
{
    SInt16      a;
    ControlRef  controlRef;
    Str255      theString = "\p";

    for(a = iEditTextTitle;a <= iEditTextDate;a++)
    {
        GetDialogItemAsControl(gDialogRef,a,&controlRef);
        SetControlData(controlRef,kControlEntireControl,kControlEditTextTextTag,theString[0],
                        &theString[1]);
        Draw1Control(controlRef);

        if(a == iEditTextTitle)
            SetKeyboardFocus(GetDialogWindow(gDialogRef),controlRef,kControlFocusNextPart);
    }
}

// ***** numericFilter

ControlKeyFilterResult numericFilter(ControlRef controlRef,SInt16* keyCode,SInt16 *charCode,
                                    EventModifiers *modifiers)
{
    if(((char) *charCode >= '0') && ((char) *charCode <= '9') || (char) *charCode == '.' ||
        (BitTst(modifiers,15 - cmdKeyBit)))
    {
        return kControlKeyFilterPassKey;
    }

    switch(*charCode)
    {
        case kLeftArrow:
        case kRightArrow:
        case kUpArrow:
        case kDownArrow:
        case kBackspace:
        case kDelete:
            return kControlKeyFilterPassKey;
            break;
    }

    SysBeep(10);
    return kControlKeyFilterBlockKey;
}

```

```
// ***** helpTags

void helpTags(void)
{
    HMHelpContentRec helpContent;
    SInt16 a;
    static SInt16 itemNumber[7] = { 1,3,21,22,23,24,25 };
    ControlRef controlRef;

    HMSetTagDelay(5);
    HMSetHelpTagsDisplayed(true);
    helpContent.version = kMacHelpVersion;
    helpContent.tagSide = kHMOOutsideTopCenterAligned;

    helpContent.content[kHMMMinimumContentIndex].contentType = kHMStringResContent;
    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmResID = 128;

    for(a = 1;a <= 7; a++)
    {
        helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = a;
        GetDialogItemAsControl(gDialogRef,itemNumber[a - 1],&controlRef);
        HMSetControlHelpContent(controlRef,&helpContent);
    }
}

// *****
```

## Demonstration Program DateTimeNumbers Comments

When this program is run, the user should enter data in the four edit text controls, using the tab key or mouse clicks to select the required control and pressing the Return key or clicking the Enter Record button when data has been entered in all controls. Note that numeric filters are used in the Quantity and Value edit text controls.

In order to observe number formatting effects, the user should occasionally enter very large numbers and negative numbers in the Value field. In order to observe the effects of date string parsing and formatting, the user should enter dates in a variety of formats, for example: “2 Mar 95”, “2/3/95”, “March 2 1995”, “2 3 95”, and so on.

### Global Variables

gDateCacheRec is used within the function doDate.

### main

The call to InstallEventLoopTimer installs a timer which will fire repeatedly at the interval returned by the call to GetCaretTime. When the timer fires, the function doIdle is called. In addition to calling IdleControls, doIdle updates the current time displayed in a static text control in the top of the dialog.

`doTodaysDate` is called to get the date and set it in a static text control at the top of the dialog.

In the function `doDate`, the function that creates the long date-time structure takes an initialized date cache structure as a parameter. The call to `InitDateCache` initializes a date cache structure.

### **windowEventHandler**

Note that all events are passed to `DialogSelect`.

When the `kEventMouseDown` event is received, if the Enter Record push button was hit, the function `doAcceptNewRecord` is called, following which `doClearAllFields` is called to clear all of the edit text controls. The same occurs when the `kEventRawKeyDown` event is received if the key pressed was Return or Enter.

### **doldle**

`doIdle`, which is called when the timer fires, blinks the insertion point caret and sets the current time in the static text control at top-right in the dialog.

If the program is running on Mac OS 8/9, `IdleControls` is called to ensure that the caret blinks regularly in the edit text control with current keyboard focus. (On Mac OS X, these controls have their own in-built timers.)

`GetDateTime` retrieves the “raw” seconds value, as known to the system. (This is the number of seconds since 1 Jan 1904.) If that value is greater than the value retrieved the last time `doIdle` was called, `TimeString` converts the raw seconds value to a string containing the time formatted according to flags in the numeric format (`'it10'`) resource. (Because NULL is specified in the resource handle parameter, the appropriate `'it10'` resource for the current script system is used.) This string is then set in the static text control, following which `Draw1Control` is called to redraw the control. The retrieved raw seconds value is assigned to the static variable `oldRawSeconds` for use next time `doIdle` is called.

### **doTodaysDate**

`doTodaysDate` sets the date in the static text control at top-left of the dialog.

`GetDateTime` gets the raw seconds value, as known to the system. `DateString` converts the raw seconds value to a string containing a date formatted in long date format according to flags in the numeric format (`'it10'`) resource. (Because NULL is specified in the resource handle parameter, the appropriate `'it10'` resource for the current script system is used.) This string is then set in the static text control.

### **doAcceptNewRecord**

`doAcceptNewRecord` is called when the Return or Enter key is pressed, or when the Enter Record button is clicked. Assuming each edit text control contains at least one character of text, it calls other functions to format (where necessary) and display strings in the “Last Record Entered” group box area.

The calls to `GetDlgItem` get the handle in the `hText` field of each edit text control's `TextEdit` structure, allowing the calls to `GetDlgItemText` to get the text into four local variables of type `Str255`.

If the length of any of these strings is 0, the system alert sound is played and `doAcceptNewRecord` returns.

The text from the Item Title and Quantity edit text controls are set in the relevant static text controls within the Last Record Entered group box, and `Draw1Control` is called to draw those controls. `doUnitAndTotalValue` and `doDate` are then called.

### **doUnitAndTotalValue**

`doUnitAndTotalValue` is called by `doAcceptNewRecord` to convert the string from the Value edit text control to a floating point number, convert that number to a formatted number string, set that string in the relevant static text control, convert the string from the Quantity edit text control to an integer, multiply the floating point number by the integer to arrive at the “Total Value” value, convert the result to a formatted number string, and set that string in the relevant static text control.

A pointer to a number parts table is required by the functions that convert between floating point numbers and strings. Accordingly, the first three lines get the required pointer.

`StringToFormatRec` converts the number format specification string into the internal numeric representation required by the functions that convert between floating point numbers and strings.

`StringToExtended` converts the received Value string into a floating point number of type extended (80 bits). `ExtendedToString` converts that number back to a string, formatted according to the internal numeric representation of the number format specification string. That string is then set in the relevant static text control and `Draw1Control` is called to draw that control.

The intention now is to multiply the quantity by the unit value to arrive at a total value. The string received in the `quantityString` formal parameter is converted to an integer value of type `SInt32` by `StringToNum`. The extended80 value is converted to a value of type `double` before the multiplication occurs. The result of the multiplication is assigned to the variable of type `double`. This is then converted to an extended80.

The extended80 value is then passed in the first parameter of `ExtendedToString` for conversion to a formatted string. If `ExtendedToString` does not return `fFormatOverflow`, the formatted string is set in the relevant static text control and `Draw1Control` is called to draw that control.

**doDate**

`doDate` is called by `doAcceptNewRecord` to create a long date-time structure from the string in the “Date” edit text control, format the date as a string (long date format), and set that string in the relevant static text control.

A pointer to the string containing the date as entered by the user, and the length of that string, are passed in the call to `StringToDate`. `StringToDate` parses the input string and fills in the relevant fields of the long date-time structure.

The function `StringToDate` fills in only the year, month, day, and day of the week fields of a long date-time structure. The function `StringToTime` fills in the hour, minute, and second. If you do not call `StringToTime`, as is the case here, you need to zero the time-related fields of the long date-time structure. If this is not done, the call to `LongDateToSeconds` will return an erroneous value. (`LongDateToSeconds` always assumes that all the fields of the long date-time structure passed to it are valid.)

`LongDateToSeconds` converts the long date-time structure to a long date-time value. The long date-time value is then passed as a parameter to `LongDateString`, which converts the long date-time value to a long format date string formatted according to the specified international resource. (In this case, `NULL` is passed as the international resource parameter, meaning that the appropriate ‘it11’ resource for the current script system is used.)

The formatted date string is then set in the relevant static text control and `Draw1Control` is called to draw that control.





# Lists and Custom List Definition Functions

## CHAPTER

# 22

## IN THIS CHAPTER

- Introduction to Lists 1238
- Appearance and Features of Lists 1238
- Selection of Cells Using the Mouse 1240
- Selection of Cells Using the Keyboard 1241
- Creating, Disposing Of, and Managing Lists 1243
- The List Box Control 1254
- Custom List Definition Functions 1257
- Main List Manager Constants, Data Types, and Functions 1259
- Relevant Text Utilities Data Type and Functions 1262
- Demonstration Program Lists Listing 1262
- Demonstration Program Lists Comments 1290



## Introduction to Lists

If you need the user to be able to select a single item from a small group of items, you typically provide a pop-up menu. Pop-up menus, however, do not allow the user to select multiple items from a group of items, are not especially suitable for the presentation of large numbers of items, and cannot present items in columns as well as rows. Furthermore, the items in a pop-up menu remain displayed only as long as the user holds the mouse button down.

By using **lists** to present a group of items to the user, you can overcome these limitations. Although lists, like pop-up menus, are generally used to solicit the user's choices, they can also be used to simply present information. Perhaps the most familiar example of such a list is that at the bottom of the window opened when you choose About This Computer from the Mac OS 8/9 Apple menu.

In essence, then, the List Manager allows you to create either one-column or multicolumn scrollable lists which may be used to simply present items of information or, as is most often the case, to enable the user to select one or more of a group of items.

By default, the List Manager creates lists that contain only monostyled text. However, with a little additional effort, you can create lists which display items graphically (as does the list on the left side of the window opened when you choose Chooser from the Mac OS 8/9 Apple menu), or which display more than one type of information in each item (as does the list in the Mac OS 8/9 About This Computer window).

## List Manager Limitations

The List Manager is not suitable for displaying large amounts of data. The limiting size for list data is 32KB, and performance degrades well before that limit is reached.

## Options for Creating and Managing Lists

You can use the List Manager function `LNew` to create a list, in which case you must provide all the functions necessary to add rows and data to the list, handle mouse and keyboard events, and so on. Alternatively, you can use the **list box control** to simplify the matter of list creation and handling.

The first section of this chapter addresses the former method and the subject of lists in general. The second section addresses the list box control, and indicates those areas in the first section which are not relevant when you use list box controls.

## Appearance and Features of Lists

Fig 1 shows a dialog with two typical single-column lists. The items in the list on the left are exclusively text items and the items in the list on the right are recorded pictures comprising a graphic and a title string. The list on the left supports the selection of multiple items.

To create a list with graphical elements, such as the list at the right in Fig 1, you must write a custom **list definition function**, because the default list definition function only supports the display of text.

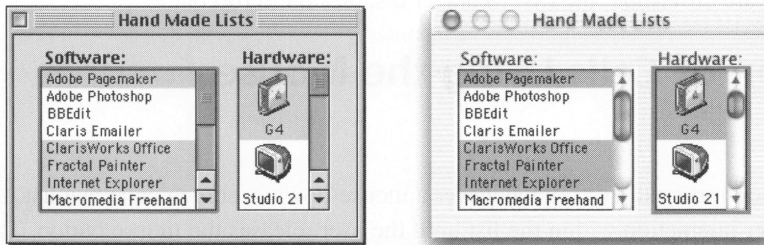


FIG 1 - DIALOG BOX WITH TWO LISTS

## Cells

A list is a number of items displayed within a rectangle, each item being contained within an invisible rectangular **cell**. Cells may contain different types of data, but all cells within a particular list are of the same size.

## Cell Font

By default, lists inherit the font of the graphics port associated with the window or dialog in which they reside. Ordinarily, your text-only lists should use the large or small system font.

### NOTE

In the case of list control boxes, the font may be set using *SetControlFontStyle* or a 'dftb' resource.

Regardless of the font your application uses, if a string is too long to fit in its cell using the current font, the List Manager uses condensed type in an attempt to make it fit (Mac OS 8/9 only). Failing that, the List Manager truncates the string and appends the ellipsis character.

## Cell Highlighting

Your application may or may not allow the user to select one or more cells in a list. If your application allows users to select cells, then, when the user selects a cell, the List Manager automatically highlights that cell.

## Scroll Bars

Lists may contain scroll bars, which allow you to include more items in a list than can be contained within the list's display rectangle. If a list includes a scroll bar but the number of cells is such that they are all visible, the List Manager disables the scroll bar.

## Selection of Cells Using the Mouse

### LClick

Your application must call `LClick` whenever a mouse-down occurs in an active list. `LClick` handles all user interaction within the list until the user releases the mouse button. This includes cell highlighting and, when the user drags the mouse outside the list's display rectangle, automatic list scrolling. `LClick` also examines the state of the Shift and Command keys, which are central to the process of multiple cell selection in lists.

## Multiple Cell Selection Using the Default Cell-Selection Algorithm

The List Manager's cell-selection algorithm allows the user to select a contiguous range of cells, or even several discontinuous ranges of cells, by using the Shift and Command keys in conjunction with the mouse. The following describes the default cell-selection behavior.

### NOTE

If the user presses both the Shift and Command keys when clicking a cell, the Shift key is ignored.

### Cell Selection with the Shift Key

The user can extend a selection of just one cell to several contiguous cells by pressing the Shift key and clicking another item. By clicking and dragging with the Shift key down, the user can extend or shrink the range of selected cells. If the cursor is dragged outside the list's display rectangle, the list will scroll so as to enable the user to include cells which were not initially visible.

### Cell Selection with the Command Key

A range of cells may be added or deleted from the current selection by pressing the Command key and then dragging the cursor over other cells. The List Manager checks the status of the first cell clicked in so as to determine whether to add or remove selections. All cells in the

range over which the cursor passes will be deselected if that first cell is initially selected. On the other hand, all cells in the range over which the cursor passes will be selected if that first cell is initially not selected.

When a cell's selection status is changed by Command-dragging, that selection status remains the same for the duration of the drag—that is, it will not change if the user moves the cursor back over the cell. The effect of the Command key thus differs from that of the Shift key in this respect.

## Shift-Clicking—Noncontiguous Cells Selected

Noncontiguity is lost if the user Shift-clicks a cell after having previously created noncontiguous selections. The List Manager selects all cells in the range of the selected cell closest to the top of the list and the newly selected cell—unless the newly selected cell precedes the first selected cell, in which case the List Manager selects all cells in the range of the newly selected cell and the selected cell closest to the bottom of the list.

## Customizing the Cell-Selection Algorithm

As will be seen, the List Manager's cell-selection algorithm may easily be customized so as to modify its default behavior. The most common modification is to defeat multiple cell selection, allowing the user to select only one cell.

## Selection of Cells Using the Keyboard

Some users prefer to use the keyboard to select cells in lists. Your application should support the following methods of cell selection via the keyboard:

- **Cell Selection Using Arrow Keys.** This method involves the use of the Arrow keys to move and extend cell selections.
- **Type Selection.** This method involves the user simply typing the text associated with an item. It is thus only relevant to text-only lists (or lists whose items can be identified by text strings).

## Cell Selection Using Arrow Keys

The List Manager does not provide any functions to support cell selection by Arrow key. Accordingly, your application must supply all of the necessary code. The following describes what that code should do.

## Moving the Selection Using Arrow Keys

### Shift and Command Keys Not Down

When the user presses an Arrow key, and is not at the same time pressing the Shift or Command key, the selection should be moved by one cell.

If the user presses the Up Arrow, for example, your application should respond by selecting the cell which is above the first selected cell and by deselecting all other selected cells. (Of course, if the first selected cell is the topmost cell in the list, your application should respond by simply deselecting all cells other than the first selected cell.) If necessary, your application should then scroll the list to ensure that the newly selected cell is visible.

### Command Key Down

When the user presses an Arrow key while at the same time pressing the Command key, your application should move the first selected cell or the last selected cell (depending on which arrow key is used) as far as it can move in the appropriate direction. For example, in a single-column list, pressing the Up Arrow key should select the first cell in the list, deselect all other cells, and scroll the list, if necessary, to ensure that the newly selected cell is visible.

### Extending the Selection Using Arrow Keys

When the user presses an Arrow key while the Shift key is down, the user is attempting to **extend** the selection. There are two alternative algorithms your application can use to respond to Shift-Arrow key combinations: the **extend algorithm** and the **anchor algorithm**. The easiest one to implement is the extend algorithm.

#### The Extend Algorithm

Using the extend algorithm, your application simply finds the first (or last) selected cell, and then selects another cell in the direction of the Arrow key. For example, if the user presses Shift-Down Arrow in a single-column list, the application should find the last selected cell and select the cell immediately below it, or, if the user presses Shift-Up Arrow, the application should find the first selected cell and select the cell above it. As always, the list should then be scrolled, if necessary, to make the newly selected cell visible.

### Type Selection

The List Manager does not provide any functions to support type selection, although the Text Utilities provide a data type and functions which support this method of keyboard selection. That said, your application must provide most of the code. The following describes what that code should do.

In a text-only list, when the user types the text of an item in a list, the list should scroll to that cell and select it.

However, rather than requiring the user to type the entire text of the item before searching for a match, your application should repeatedly search for a match as each character is entered. Accordingly, every time the user types a character, your application should add it to a string. If this string is currently two characters long, for example, your application should then walk the cells of the list, comparing these two characters with the first two characters of the text in each

cell. If a match is found, that cell should be selected and the list scrolled, if necessary, to make the cell visible.

Your application should automatically reset the internal string to a null string when the user has not pressed a key for a given amount of time. To make your application consistent with other applications and the Finder, this time should be twice the number of ticks contained in the low memory global `KeyThresh`. (The value in `KeyThresh` is set by the user at the Delay Until Repeat section of the Keyboard control panel (Mac OS 8/9) and System Preferences/Keyboard (Mac OS X).)

## Implementing Type Selection

To implement type selection, your application must store the characters the user has typed and the time when the user last typed a character. The Text Utilities `TypeSelectRecord` structure may be used for this purpose:

```
struct TypeSelectRecord
{
    unsigned long tsrLastKeyTime; // Time when the last character was typed
    ScriptCode    tsrScript;
    Str63         tsrKeyStrokes; // Characters typed by the user
};
typedef struct TypeSelectRecord TypeSelectRecord;
```

The Text Utilities function `TypeSelectNewKey` adds a new character to the `tsrKeyStrokes` field.

A global variable of type `SInt16` should be used to store the number of ticks after which type selection must be reset. The low memory accessor function `LMGetKeyThresh` might be used to obtain the value in the low memory global `KeyThresh`.

The Text Utilities function `TypeSelectClear` might be used to reset the `tsrKeyStrokes` and `tsrLastKeyTime` fields of the `TypeSelectRecord` structure to `NULL` and `0` respectively.

`LSearch` should be called to search the list's cells for a match with the specified characters, a universal procedure pointer to a comparison function being passed in the `searchProc` parameter.

## Creating, Disposing of, and Managing Lists

### The List Structure

The **list structure**, which the List Manager uses to keep track of information about a list, is central to the creation and management of lists. Although the list structure is not opaque, you are encouraged to access the list structure indirectly using the provided accessor functions because this will give your application greater threading capability on Mac OS X.

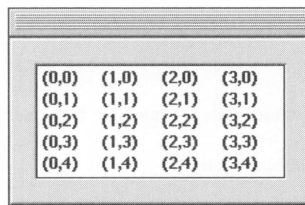
Before describing the list structure and its associated accessor functions, however, it is necessary to describe another data type used exclusively by the List Manager—that is, the `Cell` data type.

## The Cell Data Type

A cell in a list can be described by the `Cell` data type, which has the same structure as the `Point` data type:

```
typedef Point Cell;
```

The `Cell` data type's fields, however, have a different meaning from those of the `Point` data type. In the `Cell` data type, the `h` field specifies the row number and the `v` field specifies the column number. The first cell in a list is defined as cell (0,0). Fig 2 shows a multicolumn list in which each cell's text is set to the coordinates of the cell.



(0,0)	(1,0)	(2,0)	(3,0)
(0,1)	(1,1)	(2,1)	(3,1)
(0,2)	(1,2)	(2,2)	(3,2)
(0,3)	(1,3)	(2,3)	(3,3)
(0,4)	(1,4)	(2,4)	(3,4)

FIG 2 - CELL COORDINATES

## The ListRec Structure

The list structure is defined by the `ListRec` data type:

```
struct ListRec
{
    Rect          rView;           // List's display rectangle.
    GrafPtr       port;           // List's graphics port.
    Point         indent;         // Indent distance for drawing.
    Point         cellSize;       // Size in pixels of a cell.
    Rect          visible;        // Boundary of visible cells.
    ControlRef    vScroll;        // Vertical scroll bar.
    ControlRef    hScroll;        // Horizontal scroll bar.
    SInt8         selFlags;       // Selection flags.
    Boolean       lActive;        // true if list is active.
    SInt8         lReserved;      // (Reserved.)
    SInt8         listFlags;      // Automatic scrolling flags.
    long          clickTime;      // TickCount at time of last tick.
    Point         clickLoc;       // Position of last click.
    Point         mouseLoc;       // Current mouse location.
    ListClickLoopUPP lClickLoop; // Function called by LClick.
    Cell          lastClick;      // Last cell clicked.
    long          refCon;         // For application use.
}
```



```

Handle      listDefProc; // List definition function.
Handle      userHandle;  // For application use.
ListBounds  dataBounds;  // Boundary of cells allocated.
DataHandle  cells;       // Cell data.
short       maxIndex;    // (Used internally.)
short       cellArray[1]; // Offsets to data.
};

```

```

typedef struct ListRec ListRec;
typedef ListRec *ListPtr;
typedef ListPtr *ListHandle;

```

## Field Descriptions and Associated Accessor Functions

**rView** The list's visible rectangle (local coordinates). This does not include the area occupied by the list's scroll bars (if any).

Accessor Functions: `GetListViewBounds` and `SetListViewBounds`

**port** The graphics port of the window containing the list. The coordinates of the list's visible rectangle are local to this port.

Accessor Functions: `GetListPort` and `SetListPort`

**indent** The location, relative to the upper left corner of the cell, at which drawing should begin. For example, the default list definition function sets the vertical coordinate of this field to near the bottom of the cell so that characters drawn with QuickDraw's `DrawText` function are centered vertically in the cell.

Accessor Functions: `GetListCellIndent` and `SetListCellIndent`

**CellSize** The size (in pixels) of each cell in the list. For text-only lists, you usually let the List Manager automatically calculate the cell dimensions. In this case, the List Manager adds the ascent, descent and leading of the port's font to arrive at the height of a cell (which works out as 16 pixels for 12-point Charcoal on Mac OS 8/9, for example). You should make the height of your list equal to a multiple of cell height. For cell width, the List Manager divides the width of the list's display rectangle by the number of columns in the list.

Accessor Functions: `GetListCellSize` and `SetListCellSize`

**visible** Specifies those cells in a list that are visible within the `rView` rectangle. The `left` and `top` fields are set by the List Manager to the coordinates of the first visible cell. The `right` and `bottom` fields are set to one greater than the horizontal and vertical coordinates of the last visible cell. If, for example, the first three columns and six rows are visible (that is, the last visible cell has coordinates (2,5)), the List Manager sets the `visible` field to (0,0,3,6).

The List Manager sets the `right` and `bottom` fields to one greater than the horizontal and vertical coordinates of the last visible cell so as to facilitate the use of QuickDraw's `PtInRect` function to determine whether a cell is currently visible. When `PtInRect` is used for this purpose,



a `Cell` variable is passed as the first parameter and the `visible` field is passed as the second parameter. When `PtInRect`'s parameters are expressed as cell coordinates, the cells “hang” down and to the right of the mathematical rectangle. Thus, in the above example, if the cell passed as the first parameter to `PtInRect` specifies row 6 or higher or column 3 or higher, `PtInRect` returns `false`.

The fact that the `visible` field is set in this way also means that the number of visible rows and columns may be determined by simply subtracting the value in the top field from the value in the bottom field (rows) and the value in the left field from the value in the right field (columns).

Accessor Functions: `GetListVisibleCells` and `SetListVisibleCells`

`vScroll` Handle to the vertical scroll bar (or `NULL` if there is no vertical scroll bar).

Accessor Functions: `GetListVerticalScrollBar` and `SetListVerticalScrollBar`

`hScroll` Handle to the horizontal scroll bar (or `NULL` if there is no horizontal scroll bar).

Accessor Functions: `GetListHorizontalScrollBar` and `SetListHorizontalScrollBar`

`selFlags` The algorithm the List Manager uses to select cells in response to a click in the list.

Accessor Functions: `GetListSelectionFlags` and `SetListSelectionFlags`

`lActive` `true` if a list is active or `false` if it is inactive. (Do not change this field directly. Use `LActivate` to activate or deactivate a list.)

Accessor Functions: `GetListActive` and `LActivate`

`listFlags` Flags indicating whether automatic vertical and horizontal scrolling is enabled. If automatic scrolling is enabled, the list scrolls when the user clicks a cell and then drags the cursor out of the `rView` rectangle. If the list has the associated scroll bar (horizontal or vertical), automatic scrolling is enabled by default. The following constants are used to specify whether horizontal and vertical autoscrolling should be enabled or disabled:

```
lDoVAutoscroll = 2    Allows vertical scrolling.
lDoHAutoscroll = 1    Allows horizontal scrolling.
```

Accessor Functions: `GetListFlags` and `SetListFlags`

`clickTime` The time when the user last clicked the mouse.

Accessor Functions: `GetListClickTime` and `SetListClickTime`

`clickLoc` The local coordinates of the last mouse click.

Accessor Function: `GetListClickLocation`

`mouseLoc` Current location of the cursor in local coordinates.

Accessor Function: `GetListMouseLocation`

`lClickLoop` Contains NULL if the default click loop function is to be used. However, your application can assign a universal procedure pointer to a custom click-loop function to this field. Your application will not need a custom click-loop function unless it needs to perform some special processing while the user drags the cursor.

Accessor Functions: `GetListClickLoop` and `SetListClickLoop`

`lastClick` Cell coordinates of the last click. You can access the value in this field using `LLastClick`.

Accessor Function: `SetListLastClick`

`refCon` For your application's use.

Accessor Functions: `GetListRefCon` and `SetListRefCon`

`listDefProc` Handle to the list definition function code.

Accessor Functions: `GetListDefinition` and `SetListDefinition`

`userHandle` For your application's use. Typically, applications use this field to store a handle to some additional storage associated with a list.

Accessor Functions: `GetListUserHandle` and `SetListUserHandle`

`dataBounds` The total cell dimensions of the list. It is similar to the `visible` field in that its right and bottom fields are each set to one greater than the horizontal and vertical coordinates of the last cell, except that, in this case, the "last cell" is the last cell in the list, not the last cell in the visible rectangle. For example, if a list contains 5 columns and 12 rows (that is, the last cell in the list has coordinates (4,10)), the `dataBounds` field is set to (0,0,5,12).

Accessor Function: `GetListDataBounds`

`cells` Handle to a relocatable block where cell data is stored. Because of the way this field is defined, no list can contain more than 32,000 bytes of data.

Accessor Functions: `GetListDataHandle`

`cellArray` Offsets to data in the relocatable block specified by the `cells` field. Do not change the `cells` field, or access the information in the `cellArray` field, directly.

The fields of a list structure that you will be most concerned with are the `rView`, `port`, `cellSize`, `visible`, and `dataBounds` fields.

## Creating Lists

### Creating Lists That Do Not Use a Custom List Definition Function

If you are creating a list that does not use a custom list definition function, you should use the function `LNew` to create the list:

```
ListHandle LNew(const Rect *rView, const ListBounds *dataBounds, Point cSize,
                short theProc, WindowRef theWindow, Boolean drawIt, Boolean hasGrow,
                Boolean scrollHoriz, Boolean scrollVert);
```

**rView** Rectangle in which to display the list. This rectangle is in the local coordinates of the window passed in the `theWindow` parameter, and does not include the area occupied by the list's scroll bars.

**dataBounds** Initial data bounds. For example, to create a list with 5 columns and 10 rows, set the `left` and `top` fields to (0,0) and the `right` and `bottom` fields to 5 and 10 respectively.

**cSize** Size of each cell. If your application is using the default list definition function and passes (0,0) in this field, the size is calculated automatically.

**theProc** Pass 0 in this parameter to cause the default list definition function to be used.

**theWindow** Reference to the window in which the list is to be installed.

**drawIt** Specifies whether automatic drawing mode is to be initially enabled. When automatic redrawing is enabled (by setting this parameter to `true`), the list is automatically redrawn whenever it is changed.

This setting can be changed later using `LSetDrawingMode`. If your application chooses to disable automatic drawing mode (for example, for aesthetic reasons while adding rows and columns to a list) it should do so only for short periods of time.

**hasGrow** Specifies whether space should be left for a size box/resize control.

**scrollHoriz** Pass `true` if your list requires a horizontal scroll bar, otherwise pass `false`.

**scrollVert** Pass `true` if your list requires a vertical scroll bar, otherwise pass `false`.

### Creating Lists That Use a Custom List Definition Function

If you are creating a list that uses a custom list definition function, you should use the function `CreateCustomList` to create the list:

```
OSStatus CreateCustomList(const Rect *rView, const ListBounds *dataBounds,
                          Point cellSize, const ListDefSpec *theSpec,
                          WindowRef theWindow, Boolean drawIt, Boolean hasGrow,
                          Boolean scrollHoriz, Boolean scrollVert, ListHandle *outList);
```

The main difference between `LNew` and `CreateCustomList` is that the former takes the resource ID of a list definition function whereas the latter takes a universal procedure pointer to a list definition function.

### Carbon Note

In the Classic API, custom list definition functions are compiled separately as 'CODE' resources and the resource ID is passed in the `theProc` parameter of `LNew`. In Carbon, custom definition functions (and, indeed, all other custom definition functions) cannot be stored in resources; accordingly, the function `CreateCustomList` was introduced with Carbon to accommodate that situation.

### Drawing List Box Frame

The List Manager does not draw the list box frame around the list. Accordingly, this must be drawn by your application.

### Drawing Focus Rectangle

In a window with multiple lists, you need to indicate to the user which list is the current list, that is, which list is the target of current mouse and keyboard activity. Accordingly, you should draw a focus rectangle around the current list. (See the list on the left in Fig 1). The focus rectangle should be removed when the window or dialog containing the lists is deactivated.

### NOTE

A single list in a window should also be outlined with a focus rectangle if keyboard input could have some other effect in the window not related to the list (for example, if the list is in a dialog containing both a list and an edit text item).

### Disposing of a List

When you are finished with a list, you should dispose of it using `LDispose`, which disposes of the list structure as well as the data associated with the list. `LDispose` does not, however, dispose of any application-specific data you might have stored in a relocatable block specified by the `userHandle` field of the list structure. This should be separately disposed of before the call to `LDispose`.

### Adding Rows and Columns to a List

When an application creates a list, it might choose to, for example, pre-allocate the columns it needs and then add rows to the list one by one. It might also create the list and add both rows and columns to it later.

Rows are inserted into a list using `LAddRow` and deleted using `LDe1Row`. Columns are inserted in a list using `LAddColumn` and deleted using `LDe1Column`.

## Disabling and Enabling the Automatic Drawing Mode

`LSetDrawingMode` should be used to turn off the automatic drawing mode before making changes to a list. After the changes have been made, `LSetDrawingMode` should be called again, this time to turn the automatic drawing mode back on.

`InvalWindowRect` should be called after the second call to `LSetDrawingMode` to invalidate the rectangle containing the list and its scroll bars. `LUpdate`, which should be called when your application receives an update event, will then redraw the list.

## Responding to Events in a List

### Mouse-Down Events

As previously stated, when a mouse-down event occurs in a list, including in the associated scroll bar areas, your application must call `LClick`. If the click is outside the list's display rectangle or scroll bars, `LClick` returns immediately, otherwise it handles all user interaction until the user releases the mouse button. While the mouse button is down, the List Manager performs scrolling as necessary, selects or deselects cells as appropriate, and adjusts the scroll bars.

Note that `LClick` returns `true` if the click was a double click. If the list is in a dialog, your application should respond to a double click in the same way that it would respond to a click on the default (OK) button.

In the case of multiple lists, if the mouse-down occurs inside a non-current list's display rectangle or scroll bar area, your application should call its function for changing the current list.

### Key-Down Events

If a key-down event is received, and assuming that your application supports cell selection by Arrow key and/or type selection, your application should call its appropriate functions. In the case of multiple lists, your application should also respond to Tab key presses by changing the current list.

### Update Events

If an update event (Classic event model) or `kEventWindowDrawContent` event type (Carbon event model) is received, your application must call `LUpdate` to redraw the list. The region specified in the first parameter to the `LUpdate` call is usually the window's visible region as retrieved by `GetPortVisibleRegion`.

Your application will also need to draw the list box frame in the correct state (window active or inactive) and, if a focus rectangle is required and the window is active, the focus rectangle.

## Activate Events

If an activate event (Classic event model) or `kEventWindowActivated` or `kEventWindowDeactivated` event type is received (Carbon event model), your application must call `LActivate` to activate or deactivate the list as appropriate. Your application will also need to draw the list box frame in the correct state, and either draw or erase the keyboard focus rectangle, depending on whether the window is becoming active or inactive.

If your application supports type selection in a list, it will also need to reset certain type selection variables when the window containing that list is becoming active.

## Getting and Setting List Selections

The List Manager provides functions for determining which cells are currently selected and for selecting and deselecting cells. `LGetSelect` is used to either determine whether a specified cell is selected or to keep advancing from a specified starting cell until the next selected cell is found. `LSelSelect` is used to select or deselect a specified cell.

`LNextCell`, which simply advances from one cell in a list to the next, is often used in functions associated with getting and setting list selections.

## Scrolling a List

`LAutoScroll` may be used to scroll the first selected cell to the upper-left corner of the list's display rectangle.

`LScroll` allows your application to scroll the list by a specified number of rows and/or columns. Typically, you would use `LScroll` when you want your application to scroll a list just enough so that a certain cell (such as the cell the user has just selected using the an Arrow key or type selection) is visible.

## Storing Data

Your application can store data in a cell using `LSetCell`. `LSetCell`'s parameters include a pointer to the data, the length of the data, the location of the cell whose data you wish to set, and a handle to the list containing the cell. The data stored in a cell might be sourced from, for example, a string list resource.

## Adding to Data

Your application can append data to a cell using `LAddToCell`.

## Getting Cell Data

`LGetCell` may be used to copy the contents of a cell into a buffer. `LGetCellDataLocation` may be used to obtain the address and length of a cell's data. Unlike `LGetCell`, `LGetCellDataLocation` does not make a copy of the data, and should thus be used when you want to access, but not manipulate, the data.

## Clearing Data

Your application can remove all data from a cell using `LClrCell`.

## Searching a List

Your application can use `LSearch` to search through a list for a particular item. `LSearch` takes, as one parameter, a universal procedure pointer to a **match function**. If `NULL` is specified for this parameter, `LSearch` searches the list for the first cell whose data matches the specified data, calling the Text Utilities `IdenticalString` function to compare each cell's data with the specified data until `IdenticalString` returns 0, indicating that a match has been found.

## Custom Match Functions

The default match function is useful for text-only lists. Your application can use a different match function to facilitate searches in other types of lists as long as that function is defined just like `IdenticalString`.

A common custom match function is one which supports type selection in lists, that is, one which works like the default match function but which allows the cell data to be longer than the data being searched for. For example, a search for the string “be” would match a cell containing the string “Beams.”

## Changing the Current List

As previously stated, when a window or dialog contains multiple lists, your application should allow the user to change the current list by clicking in one of the non-current lists or by pressing the Tab key or Shift-Tab. In a window with more than two lists, Tab key presses should make the next list in a predetermined sequence the current list, and Shift-Tab should make the previous list in that sequence the current list. The predetermined sequence is best implemented using a **linked ring**.

## Linked Ring

To create a linked ring, you can use the `refCon` field of each list structure. Assign the handle to the second list to the `refCon` field of the first list, assign the handle to the third list to the `refCon` field of the second list, and so on, until, to close the circle, the handle to the first list is



assigned to the `refCon` field of the last list. Then, in response to a Tab key press in the current list, your application can ascertain the next list in the ring by looking at the current list's `refCon` field.

Responding to Shift-Tab is a little more complex. The following example function shows how this can be done:

```
ListHandle gCurrentListHdl;

void doFindPreviousListInRing(void)
{
    ListHandle listHdl;

    listHdl = gCurrentListHdl;

    while((ListHandle) GetListRefCon(listHdl) != gCurrentList)
        listHdl = (ListHandle) GetListRefCon(listHdl);

    gCurrentListHdl = listHdl;
}
```

# Customizing the Cell-Selection Algorithm

You can modify the algorithm the List Manager uses to select cells in response to mouse clicking and dragging by changing the value in the `selFlags` field of the list structure. (Recall that, by default, mouse clicks deselect all cells and select the current cell, Shift-click and Shift-drag extend the selection as a rectangular range, and Command-click and Command drag toggle selections according to the selection state of the initial cell.)

The bits in the `selFlags` field are represented by the following constants. Those constants, and the effect the values they represent have on the cell-selection algorithm, are as follows:

<i>Constant</i>	<i>Value</i>	<i>Effect</i>
<code>lOnlyOne</code>	128	Allow only one cell to be selected at any one time.
<code>lExtendDrag</code>	64	Allow the user to select a range of cells by clicking the first cell and dragging to the last cell without necessarily pressing the Shift or Command key. (Ordinarily, dragging in this manner results in only the last cell being selected.)
<code>lNoDisjoint</code>	32	Prevent discontinuous selections using the Command key, while still allowing the user to select a contiguous range of cells.
<code>lNoExtend</code>	16	Cause all previously selected cells to be deselected when the user Shift-clicks.



<i>Constant</i>	<i>Value</i>	<i>Effect</i>
<code>lNoRect</code>	8	Disable the feature which allows the user to shrink a selection by Shift-clicking to select a range of cells and then dragging the cursor to a position within that range. (With this feature is disabled, all cells in the cursor's path during a Shift-drag become selected even if the user drags the cursor back over the cell.)
<code>lUseSense</code>	4	Allow the user to deselect a range of cells by Shift-dragging. (Ordinarily, Shift-dragging causes cells to become selected even if the first cell clicked is already selected.)
<code>lNoNilHilite</code>	2	Turn off the highlighting of cells which contain no data. (Note that this constant is somewhat different from the others in that it affects the display of a list, not the way that the List Manager selects items in response to a click.)

These constants are often used additively. For example, you could make the Shift key work just like the Command key using the following code:

```
SetListSelectionFlags(listHdl, lNoRect + lNoExtend + lUseSense);
```

If your application customizes the cell-selection algorithm in lists that allow multiple cell selection, it should make the nonstandard behavior clear to the user. Typically, this is done by displaying explanatory text above the list's display rectangle.

## The List Box Control

The list box control reduces the programming effort involved in managing lists. Basically, this control frees your application from the requirement to provide its own functions for attending to mouse and keyboard interaction with the list (except for type selection). To create and manage lists using the list box control, you need to

- Provide a list box 'CNTL' resource and a list box description ('ldes') resource.
- Provide functions for storing data in the list's cells and, where required, for adding rows and/or columns.
- Provide a function to support type selection, if required.
- Modify the list's cell selection algorithm, if required.
- Provide a function which searches for, and returns the data in, the selected cell or cells.

The handle to the control is assigned to the `refCon` field of the list structure. This allows a custom list definition function to determine whether the control should be drawn in the activated or deactivated state by looking at the `contrlHilite` field of the control structure.

# List Box Variants, Values, Constants, and Resources

## Variant and Control Definition ID

The list box CDEF resource ID is 22. The two available variants and their control definition IDs are as follows:

<i>Variant</i>	<i>Var Code</i>	<i>Control Definition ID</i>
List box	0	352 kControlListBoxProc
Autosizing list box	1	353 kControlListBoxAutoSizeProc

## Control Values

<i>Control Value</i>	<i>Content</i>
Initial	Resource ID of the 'lides' resource holding the list box information. Reset to 0 after creation. An initial value of 0 indicates not to read an 'lides' resource. (See The List Box Description Resource, below.)
Minimum	Reserved. Set to 0.
Maximum	Reserved. Set to 0.

## Control Data Tag Constants

<i>Control Data Tag Constant</i>	<i>Meaning and Data Type Returned or Set</i>
kControlListBoxListHandleTag	Gets a handle to a list box. <b>Data type returned:</b> ListHandle
kControlListBoxDoubleClickTag	Checks to see whether the most recent click in a list box was a double click. <b>Data type returned:</b> Boolean. If true, the last click was a double click. If false, not.
kControlListBoxKeyFilterTag	Gets or sets a key filter function. <b>Data type returned or set:</b> ControlKeyFilterUPP
kControlListBoxFontStyleTag	Gets or sets the font style. <b>Data type returned or set:</b> ControlFontStyleRec

## Control Part Codes

<i>Constant</i>	<i>Value</i>	<i>Description</i>
kControllListBoxPart	24	Event occurred in a list box.
kControllListBoxDoubleClickPart	25	Double-click occurred in a list box.

## The List Box Description Resource

The list box description ('lides') resource, which must have resource ID of greater than 127, is used to specify information for a list box. The information is used by The Control Manager to provide additional information to the relevant list box control. Fig 3 shows the structure of a compiled 'lides' resource and such a resource being created using Resorcerer.

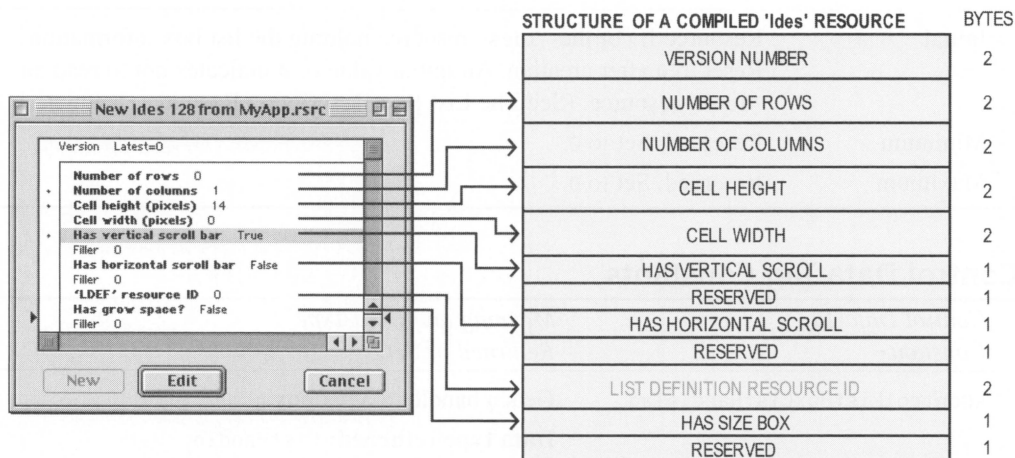


FIG 3 - CREATING AN 'lides' RESOURCE USING RESORCERER

The following describes the main fields of a compiled 'lides' resource:

<i>Field</i>	<i>Description</i>
NUMBER OF ROWS	The number of rows in the list box.
NUMBER OF COLUMNS	The number of columns in the list box.
CELL HEIGHT	The height of the list cells. Specify 0 to cause the height to be calculated automatically.
CELL WIDTH	The width of a the list cells. Specify 0 to cause the width to be calculated automatically.

<i>Field</i>	<i>Description</i>
HAS VERTICAL SCROLL BAR	true causes the list box to contain a vertical scroll bar.
HAS HORIZONTAL SCROLL BAR	true causes the list box to contain a horizontal scroll bar.
RESOURCE ID	The resource ID of the list definition function to use for the list. In Carbon, always set to 0.
HAS SIZE BOX	true causes the List Manager to leave room for, and draw, a size box.

### Programmatic Creation

List box controls may be created programmatically using the function `CreateListBoxControl`:

```
OSStatus CreateListBoxControl(WindowRef window, const Rect *boundsRect, Boolean autoSize,
    SInt16 numRows, SInt16 numColumns, Boolean horizScroll, Boolean vertScroll,
    SInt16 cellHeight, SInt16 cellWidth, Boolean hasGrowSpace,
    const ListDefSpec *listDef, ControlRef *outControl);
```

### Custom List Definition Functions

As previously stated, the default list definition function supports the display of unstyled text only. If your application needs to display items graphically, or display more than one type of information in each cell, you must create your own list definition (callback) function.

#### NOTE

For example, the MAC OS 8/9 Finder's About This Computer dialog contains a single-column list of applications currently in use. Each cell in the list contains an icon, the name of the application, the amount of memory in the application partition, and a graphical indication of how much of that memory has been used.

Your custom list definition (callback) function must be declared like this:

```
void myListDefinition(SInt16 lMessage, Boolean lSelect, Rect *lRect, Cell lCell,
    SInt16 lDataOffset, SInt16 lDataLen, ListHandle lHandle);
```

### Messages Sent by List Manager

In essence, the sole requirement of your list definition function is to respond appropriately to four types of messages sent to it by the List Manager, and which are received in the `lMessage` parameter. The following constants define the four message types:

<i>Constant</i>	<i>Value</i>	<i>Meaning</i>
<code>lInitMsg</code>	<code>0</code>	Do any special list initialization.
<code>lDrawMsg</code>	<code>1</code>	Draw the cell.
<code>lHiliteMsg</code>	<code>2</code>	Invert the cell's highlight state.
<code>lCloseMsg</code>	<code>3</code>	Take any special disposal action.

The `lSelect`, `lRect`, `lCell`, `lDataOffset`, and `lDataLen` parameters, which contain information about the cell affected by the message, pass information to your custom list definition function only when the `lDrawMsg` or `lHiliteMsg` messages are received. The `lSelect` parameter indicates whether the cell should be highlighted. `lRect` and `lCell` provide the cell's rectangle and coordinates. `lDataOffset` and `lDataLen` parameters provide the offset and length of the cell's data referenced by the `cells` field of the list structure.

## The Initialization Message

In response to the `lInitMsg` message, your application might, for example, change the `cellSize` and `indent` fields of the list structure. However, many custom list definition functions do not need to perform any action in response to the initialization message.

## The Draw Message

In response to the `lDrawMsg` message, your custom list definition function must examine the specified cell's data and draw the cell as appropriate, ensuring that the characteristics of the drawing environment are not altered.

## The Highlighting Message

In response to the `lHiliteMsg` message, your custom list definition function should highlight the cell's rectangle. The following example shows how this might be done:

```
void doLDEFHighlight(Rect *cellRect)
{
    UInt8 hiliteVal;

    hiliteVal = LMGetHiliteMode();
    BitClr(&hiliteVal, pHiliteBit);
    LMSetHiliteMode(hiliteVal);

    InvertRect(cellRect);
}
```

## Responding to the Close Message

The `lCloseMsg` is sent immediately before the List Manager disposes of the memory occupied by the list. Your custom list definition function needs to respond only if it needs to perform some special processing at that point, such as releasing any additional memory associated with the list.

# Main List Manager Constants, Data Types, and Functions

## Constants

### Masks for listFlags Field of List Structure

lDoVAutoscroll	= 2	Allow vertical autoscrolling.
lDoHAutoscroll	= 1	Allow horizontal autoscrolling.

### Masks for selFlags Field of List Structure

lOnlyOne	= -128	Allow only one item to be selected at once.
lExtendDrag	= 64	Enable multiple item selection without Shift.
lNoDisjoint	= 32	Prevent discontinuous selections.
lNoExtend	= 16	Reset list before responding to Shift-click.
lNoRect	= 8	Shift-drag selects items passed by cursor.
lUseSense	= 4	Allow use of Shift key to deselect items.
lNoNilHilite	= 2	Disable highlighting of empty cells.

### Messages to List Definition Function

lInitMsg	= 0	Do any special list initialisation.
lDrawMsg	= 1	Draw the cell.
lHiliteMsg	= 2	Invert cell's highlight state.
lCloseMsg	= 3	Take any special disposal action.

### Control Kind

kControlKindListBox = FOUR\_CHAR\_CODE('lbox')

## Data Types

```
typedef Point    Cell;
typedef Rect     ListBounds;
typedef char     dataArray[32001];
typedef char     *DataPtr;
typedef DataPtr *DataHandle;
```

### List Structure

```
struct ListRec
{
    Rect        rView;           // List's display rectangle.
    GrafPtr     port;           // List's graphics port.
    Point       indent;         // Indent distance for drawing.
    Point       cellSize;       // Size in pixels of a cell.
    Rect        visible;        // Boundary of visible cells.
    ControlRef  vScroll;        // Vertical scroll bar.
    ControlRef  hScroll;        // Horizontal scroll bar.
    SInt8       selFlags;       // Selection flags.
    Boolean     lActive;        // true if list is active.
    SInt8       lReserved;      // (Reserved.)
    SInt8       listFlags;      // Automatic scrolling flags.
    long        clikTime;       // TickCount at time of last tick.
```

```

Point      clikLoc;      // Position of last click.
Point      mouseLoc;     // Current mouse location.
ListClickLoopUPP lClickLoop; // Function called by LClick.
Cell       lastClick;     // Last cell clicked.
long       refCon;       // For application use.
Handle     listDefProc;   // List definition function.
Handle     userHandle;    // For application use.
ListBounds dataBounds;   // Boundary of cells allocated.
DataHandle cells;        // Cell data.
short      maxIndex;     // (Used internally.)
short      cellArray[1]; // Offsets to data.
};

```

```

typedef struct ListRec ListRec;
typedef ListRec *ListPtr;
typedef ListPtr *ListHandle;

```

## Functions

### Creating and Disposing of Lists

```

ListHandle LNew(const Rect *rView,const ListBounds *dataBounds,Point cSize,
short theProc,WindowRef theWindow,Boolean drawIt,Boolean hasGrow,
Boolean scrollHoriz,Boolean scrollVert);

OSStatus CreateCustomList(const Rect *rView,const ListBounds *dataBounds,
Point cellSize,const ListDefSpec *theSpec,WindowRef theWindow,Boolean drawIt,
Boolean hasGrow,Boolean scrollHoriz,Boolean scrollVert,ListHandle *outList);

void LDispose(ListHandle lHandle);

```

### Creating List Box Controls

```

OSStatus CreateListBoxControl(WindowRef window,const Rect *boundsRect,
Boolean autoSize,SInt16 numRows,SInt16 numColumns,Boolean horizScroll,
Boolean vertScroll,SInt16 cellHeight,SInt16 cellWidth,Boolean hasGrowSpace,
const ListDefSpec *listDef,ControlRef *outControl);

```

### Adding and Deleting Rows and Columns

```

short LAddColumn(short count,short colNum,ListHandle lHandle);
short LAddRow(short count,short rowNum,ListHandle lHandle);
void LDelColumn(short count,short colNum,ListHandle lHandle);
void LDelRow(short count,short rowNum,ListHandle lHandle);

```

### Determining or Changing a Selection

```

Boolean LGetSelect(Boolean next,Cell *theCell,ListHandle lHandle);
void LSetSelect(Boolean setIt,Cell theCell,ListHandle lHandle);

```

### Accessing and Manipulating Data Cells

```

void LSetCell(const void *dataPtr,short dataLen,Cell theCell,ListHandle lHandle);
void LAddToCell(const void *dataPtr,short dataLen,Cell theCell,
ListHandle lHandle);
void LClrCell(Cell theCell,ListHandle lHandle);
void LGetCellDataLocation(short *offset,short *len,Cell theCell,
ListHandle lHandle);
void LGetCell(void *dataPtr,short *dataLen,Cell theCell,ListHandle lHandle);

```

## Responding to Events

```
Boolean    LClick(Point pt,short modifiers,ListHandle lHandle);
void       LUpdate(RgnHandle theRgn,ListHandle lHandle);
void       LActivate(Boolean act,ListHandle lHandle);
```

## Modifying a List's Appearance

```
void       LSetDrawingMode(Boolean drawIt,ListHandle lHandle);
void       LDraw(Cell theCell,ListHandle lHandle);
void       LAutoScroll(ListHandle lHandle);
void       LScroll(short dCols,short dRows,ListHandle lHandle);
```

## Searching for a List Containing a Particular Item

```
Boolean    LSearch(const void *dataPtr,short dataLen,ListSearchUPP searchProc,
                  Cell *theCell,ListHandle lHandle);
```

## Changing the Size of Cells and Lists

```
void       LSize(short listWidth,short listHeight,ListHandle lHandle);
void       LCellSize(Point cSize,ListHandle lHandle);
```

## Getting Information About Cells

```
Boolean    LNextCell(Boolean hNext,Boolean vNext,Cell *theCell,ListHandle lHandle);
void       LRect(Rect *cellRect,Cell theCell,ListHandle lHandle);
Cell       LLastClick(ListHandle lHandle);
```

## List Structure Accessor Functions

```
Rect*      GetListViewBounds(ListRef list,Rect *view);
void       SetListViewBounds(ListRef list,const Rect *view);
CGrafPtr   GetListPort(ListRef list);
void       SetListPort(ListRef list,CGrafPtr port);
Point*     GetListCellIndent(ListRef list,Point *indent);
void       SetListCellIndent(ListRef list,Point *indent);
Point*     GetListCellSize(ListRef list,Point *size);
void       SetListCellSize(ListRef list,Point *size);
ListBounds * GetListVisibleCells(ListRef list,ListBounds *visible);
void       SetListVisibleCells(ListRef list,ListBounds *visible);
ControlHandle GetListVerticalScrollBar(ListRef list);
void       SetListVerticalScrollBar(ListRef list,ControlHandle vScroll);
ControlHandle GetListHorizontalScrollBar(ListRef list);
void       SetListHorizontalScrollBar(ListRef list,ControlHandle hScroll);
OptionBits GetListSelectionFlags(ListRef list);
void       SetListSelectionFlags(ListRef list,OptionBits selectionFlags);
Boolean    GetListActive(ListRef list);
OptionBits GetListFlags(ListRef list);
void       SetListFlags(ListRef list,OptionBits listFlags);
SInt32     GetListClickTime(ListRef list);
void       SetListClickTime(ListRef list,SInt32 time);
Point*     GetListClickLocation(ListRef list,Point *click);
Point*     GetListMouseLocation(ListRef list,Point *mouse);
ListClickLoopUPP GetListClickLoop(ListRef list);
void       SetListClickLoop(ListRef list,ListClickLoopUPP clickLoop);
void       SetListLastClick(ListRef list,Cell *lastClick);
SInt32     GetListRefCon(ListRef list);
```



```

void          SetListRefCon(ListRef list, SInt32 refCon);
Handle        GetListUserHandle(ListRef list);
void          SetListUserHandle(ListRef list, Handle userHandle);
Handle        GetListDefinition(ListRef list);
void          SetListDefinition(ListRef list, Handle listDefProc);
ListBounds*   GetListDataBounds(ListRef list, ListBounds *bounds);
DataHandle    GetListDataHandle(ListRef list);

```

### Creating and Disposing of Universal Procedure Pointers

```

ListSearchUPP NewListSearchUPP(ListSearchProcPtr userRoutine);
ListClickLoopUPP NewListClickLoopUPP(ListClickLoopProcPtr userRoutine);
ListDefUPP     NewListDefUPP(ListDefProcPtr userRoutine);
void           DisposeListSearchUPP(ListSearchUPP userUPP);
void           DisposeListClickLoopUPP(ListClickLoopUPP userUPP);
void           DisposeListDefUPP(ListDefUPP userUPP);

```

### Application-Defined (Callback) Function

```

void          myListDefinition(short lMessage, Boolean lSelect, Rect *lRect, Cell lCell,
                               short lDataOffset, short lDataLen, ListHandle lHandle);

```

## Relevant Text Utilities Data Type and Functions

### Data Type

```

struct TypeSelectRecord
{
    unsigned long tsrLastKeyTime;
    ScriptCode    tsrScript;
    Str63         tsrKeyStrokes;
};
typedef struct TypeSelectRecord TypeSelectRecord;

```

### Functions

```

void          TypeSelectClear(TypeSelectRecord *tsr);
Boolean       TypeSelectNewKey (const EventRecord *theEvent, TypeSelectRecord *tsr);

```

## Demonstration Program Lists Listing

```

// *****
// Lists.h                                     CARBON EVENT MODEL
// *****
//
// This program allows the user to open a window and a movable modal dialog by choosing the
// relevant items in the Demonstration menu. The window and the dialog both contain two
// lists.
//
// The cells of one list in the window, and of both lists in the dialog, contain text. The
// cells of the second list in the window contain icons.
//
// The text lists use the default list definition function. The list with the icons uses a
// custom list definition function.
//

```

```

// The currently active list is indicated by a keyboard focus frame, and can be changed by
// clicking in the non-active list or by pressing the tab key.
//
// The text list in the window uses the default cell-selection algorithm; accordingly,
// multiple cells, including discontinuous multiple cells, may be selected. The cell-
// selection algorithm for the other lists is customised so as to allow the selection of only
// one cell at a time.
//
// All lists support arrow key selection. The text list in the window and one of the lists in
// the dialog support type selection.
//
// The window is provided with an "Extract" push button. When this button is clicked, or when
// the user double clicks in one of the lists, the current selections in the lists are
// extracted and displayed in the bottom half of the window. In the dialog, the user's
// selections are displayed in static text fields embedded in placards below each list.
//
// The program utilises the following resources:
//
// . A 'plst' resource.
//
// . An 'MBAR' resource, and 'MENU' resources for Apple, File, Edit and Demonstration menus
//   (preload, non-purgeable).
//
// . A'DLOG' resource (purgeable) (initially not visible) and associated 'dlgx', 'dftb', and
//   'DITL' resources (purgeable).
//
// . 'CNTL' resources (purgeable) for various controls in both the window and dialog box,
//   including the list controls for the dialog box.
//
// . 'ldes' resources associated with the list controls for the dialog box.
//
// . 'STR#' resources (purgeable) containing the text strings for the text lists and for the
//   titles of the icons.
//
// . An icon suite (non-purgeable) containing the icons for icon list.
//
// . An 'LDEF' resource (preload, locked, non-purgeable) containing the custom list
//   definition function used by the icon list.
//
// . 'hrct' and 'hwin' (purgeable) resources for balloon help.
//
// . A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****
// ..... includes
#include <Carbon.h>
// ..... defines
#define rMenubar          128
#define mAppleApplication 128

```

```

#define iAbout                1
#define mFile                 129
#define iQuit                 12
#define mDemonstration       131
#define iHandMadeLists        1
#define iListControlLists     2
#define cExtractButton        128
#define cGroupBox             129
#define cSoftwareStaticText   130
#define cHardwareStaticText   131
#define rTextListStrings      128
#define rIconListIconSuiteBase 128
#define rIconListStrings      129
#define rListsDialog          128
#define iDateFormatList       4
#define iWatermarkList        5
#define iDateFormatStaticText  7
#define iWatermarkStaticText   9
#define rDateFormatStrings     130
#define rWatermarkStrings     131
#define kUpArrow              0x1e
#define kDownArrow            0x1f
#define kTab                   0x09
#define kScrollBarWidth       15
#define kMaxKeyThresh         120
#define kSystemLDEF            0

// ..... typedefs

typedef struct
{
    ListHandle textListHdl;
    ListHandle iconListHdl;
    ControlRef extractButtonHdl;
} docStructure, **docStructureHandle;

typedef struct
{
    RGBColor    backColor;
    PixPatHandle backPixelPattern;
    Pattern     backBitPattern;
} backColorPattern;

// ..... function prototypes

void    main                                (void);
void    doPreliminaries                    (void);
OSStatus appEventHandler                    (EventHandlerCallRef, EventRef, void *);
OSStatus windowEventHandler                 (EventHandlerCallRef, EventRef, void *);
void    doAdjustMenus                       (void);
void    doMenuChoice                        (MenuID, MenuItemIndex);
void    doSaveBackground                    (backColorPattern *);
void    doRestoreBackground                 (backColorPattern *);
void    doSetBackgroundWhite                (void);

```

```

void      doOpenListsWindow      (void);
void      doKeyDown              (SInt8,EventRecord *);
void      doDrawContent          (WindowRef);
void      doActivateDeactivate  (WindowRef,Boolean);
void      doInContent            (Point,UInt32);
void      doControlHit           (WindowRef,ControlRef,Point);
ListHandle doCreateTextList      (WindowRef,Rect,SInt16,SInt16);
void      doAddRowsAndDataToTextList (ListHandle,SInt16,SInt16);
void      doAddTextItemAlphabetically (ListHandle,Str255);
ListHandle doCreateIconList      (WindowRef,Rect,SInt16,ListDefUPP);
void      doAddRowsAndDataToIconList (ListHandle,SInt16);
void      doHandleArrowKey       (SInt8,EventRecord *,Boolean);
void      doArrowKeyMoveSelection (ListHandle,SInt8,Boolean);
void      doArrowKeyExtendSelection (ListHandle,SInt8,Boolean);
void      doTypeSelectSearch      (ListHandle,EventRecord *);
SInt16    searchPartialMatch      (Ptr,Ptr,SInt16,SInt16);
Boolean    doFindFirstSelectedCell (ListHandle,Cell *);
void      doFindLastSelectedCell  (ListHandle,Cell *);
void      doFindNewCellLoc        (ListHandle,Cell,Cell *,SInt8,Boolean);
void      doSelectOneCell         (ListHandle,Cell);
void      doMakeCellVisible       (ListHandle,Cell);
void      doResetTypeSelection     (void);
void      doRotateCurrentList     (void);
void      doDrawFrameAndFocus     (ListHandle,Boolean);
void      doExtractSelections     (void);
void      doDrawSelections        (Boolean);
void      listDefFunction         (SInt16,Boolean,Rect *,Cell,SInt16,SInt16,ListHandle);
void      doLDEFDraw              (Boolean,Rect *,Cell,SInt16,ListHandle);
void      doLDEFHighlight         (Rect *);

void      doListsDialog           (void);
Boolean    eventFilter            (DialogPtr,EventRecord *,SInt16 *);

```

```

// *****
// Lists.c
// *****

// ..... includes

#include "Lists.h"

// ..... global variables

ListDefUPP      gListDefFunctionUPP;
Boolean          gRunningOnX = false;
BackColorPattern gBackColorPattern;

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;
    MenuRef        menuRef;

```

```

EventTypeSpec applicationEvents[] = { { kEventClassApplication, kEventAppActivated },
                                       { kEventClassCommand,      kEventProcessCommand },
                                       { kEventClassMenu,          kEventMenuEnableItems } };

// ..... do preliminaries

doPreliminaries();

// ..... create universal procedure pointers

gListDefFunctionUPP = NewListDefUPP((ListDefProcPtr) listDefFunction);

// ..... set up menu bar and menus

menubarHdl = GetNewMBar(rMenubar);
if(menubarHdl == NULL)
    ExitToShell();
SetMenuBar(menubarHdl);
DrawMenuBar();

Gestalt(gestaltMenuMgrAttr,&response);
if(response & gestaltMenuMgrAquaLayoutMask)
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
    {
        DeleteMenuItem(menuRef,iQuit);
        DeleteMenuItem(menuRef,iQuit - 1);
        DisableMenuItem(menuRef,0);
    }

    gRunningOnX = true;
}
else
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
        SetMenuItemCommandID(menuRef,iQuit,kHICCommandQuit);
}

// ..... install application event handler

InstallApplicationEventHandler(NewEventHandlerUPP((EventHandlerProcPtr) appEventHandler),
                              GetEventTypeCount(applicationEvents),applicationEvents,
                              0,NULL);

// ..... run application event loop

RunApplicationEventLoop();
}

```

```
// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(256);
    InitCursor();
}

// ***** appEventHandler

OSStatus appEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                        void * userData)
{
    OSStatus      result = eventNotHandledErr;
    UInt32        eventClass;
    UInt32        eventKind;
    HICCommand     hiCommand;
    MenuID         menuID;
    MenuItemIndex  menuItem;
    WindowClass    windowClass;

    eventClass = GetEventClass(eventRef);
    eventKind  = GetEventKind(eventRef);

    switch(eventClass)
    {
    case kEventClassApplication:
        if(eventKind == kEventAppActivated)
            SetThemeCursor(kThemeArrowCursor);
        break;

    case kEventClassCommand:
        if(eventKind == kEventProcessCommand)
        {
            GetEventParameter(eventRef, kEventParamDirectObject, typeHICCommand, NULL,
                             sizeof(HICCommand), NULL, &hiCommand);
            menuID = GetMenuID(hiCommand.menu.menuRef);
            menuItem = hiCommand.menu.menuItemIndex;
            if((hiCommand.commandID != kHICCommandQuit) &&
                (menuID >= mAppleApplication && menuID <= mDemonstration))
            {
                doMenuChoice(menuID, menuItem);
                result = noErr;
            }
        }
        break;

    case kEventClassMenu:
        if(eventKind == kEventMenuEnableItems)
        {
            GetWindowClass(FrontWindow(), &windowClass);
            if(windowClass == kDocumentWindowClass)
                doAdjustMenus();
            result = noErr;
        }
    }
}
```

```

        break;
    }

    return result;
}

// ***** windowEventHandler

OSStatus windowEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                           void* userData)
{
    OSStatus          result = eventNotHandledErr;
    UInt32            eventClass;
    UInt32            eventKind;
    WindowRef          windowRef;
    EventRecord        eventRecord;
    docStructureHandle docStrucHdl;
    ControlRef          controlRef = NULL;
    ControlPartCode    controlPartCode;
    SInt8              charCode;
    UInt32             modifiers;
    Point              mouseLocation;

    eventClass = GetEventClass(eventRef);
    eventKind  = GetEventKind(eventRef);

    switch(eventClass)
    {
        case kEventClassWindow: // event class window
            GetEventParameter(eventRef, kEventParamDirectObject, typeWindowRef, NULL, sizeof(windowRef),
                              NULL, &windowRef);

            switch(eventKind)
            {
                case kEventWindowDrawContent:
                    doDrawContent(windowRef);
                    result = noErr;
                    break;

                case kEventWindowActivated:
                    doActivateDeactivate(windowRef, true);
                    result = noErr;
                    break;

                case kEventWindowDeactivated:
                    doActivateDeactivate(windowRef, false);
                    result = noErr;
                    break;

                case kEventWindowClickContentRgn:
                    GetEventParameter(eventRef, kEventParamMouseLocation, typeQDPoint, NULL,
                                      sizeof(mouseLocation), NULL, &mouseLocation);
                    SetPortWindowPort(FrontWindow());
                    GlobalToLocal(&mouseLocation);
            }
    }
}

```

```

        GetEventParameter(eventRef, kEventParamKeyModifiers, typeUInt32, NULL,
                           sizeof(modifiers), NULL, &modifiers);
        doInContent(mouseLocation, modifiers);
        result = noErr;
        break;

    case kEventWindowClose:
        docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
        LDispose((*docStrucHdl)->textListHdl);
        LDispose((*docStrucHdl)->iconListHdl);
        DisposeHandle((Handle) docStrucHdl);
        DisposeWindow(windowRef);
        result = noErr;
        break;
}
break;

case kEventClassMouse: // event class mouse
    switch(eventKind)
    {
        case kEventMouseDown:
            GetEventParameter(eventRef, kEventParamMouseLocation, typeQDPoint, NULL,
                               sizeof(mouseLocation), NULL, &mouseLocation);
            SetPortWindowPort(FrontWindow());
            GlobalToLocal(&mouseLocation);
            controlRef = FindControlUnderMouse(mouseLocation, FrontWindow(), &controlPartCode);
            if(controlRef)
            {
                doControlHit(FrontWindow(), controlRef, mouseLocation);
                result = noErr;
            }
            break;
    }
    break;

case kEventClassKeyboard: // event class keyboard
    switch(eventKind)
    {
        case kEventRawKeyDown:
            GetEventParameter(eventRef, kEventParamKeyMacCharCodes, typeChar, NULL,
                               sizeof(charCode), NULL, &charCode);
            GetEventParameter(eventRef, kEventParamKeyModifiers, typeUInt32, NULL,
                               sizeof(modifiers), NULL, &modifiers);

            eventRecord.what = keyDown;
            eventRecord.message = charCode;
            eventRecord.when = EventTimeToTicks(GetEventTime(eventRef));
            eventRecord.modifiers = modifiers;
            doKeyDown(charCode, &eventRecord);
            result = noErr;
            break;
    }
    break;
}
}

```



```

    return result;
}

// ***** doAdjustMenus

void doAdjustMenus(void)
{
    MenuRef menuRef;

    menuRef = GetMenuRef(mDemonstration);

    if(FrontWindow())
        DisableMenuItem(menuRef,1);
    else
        EnableMenuItem(menuRef,1);
}

// ***** doMenuChoice

void doMenuChoice(MenuID menuID,MenuItemIndex menuItem)
{
    if(menuID == 0)
        return;

    switch(menuID)
    {
        case mAppleApplication:
            if(menuItem == iAbout)
                SysBeep(10);
            break;

        case mDemonstration:
            if(menuItem == iHandMadeLists)
                doOpenListsWindow();
            else if(menuItem == iListControllLists)
                doListsDialog();
            break;
    }
}

// ***** doSaveBackground

void doSaveBackground(backColorPattern *gBackColorPattern)
{
    GrafPtr currentPort;
    PixPatHandle backPixPatHdl;

    GetPort(&currentPort);

    GetBackColor(&gBackColorPattern->backColor);
    gBackColorPattern->backPixelPattern = NULL;

    backPixPatHdl = NewPixPat();
    GetPortBackPixPat(currentPort,backPixPatHdl);
}

```

```

if((*backPixPatHdl)->patType != 0)
    gBackColorPattern->backPixelPattern = backPixPatHdl;
else
    gBackColorPattern->backBitPattern = *(PatPtr) (*(backPixPatHdl)->patData);

DisposePixPat(backPixPatHdl);
}

// ***** doRestoreBackground

void doRestoreBackground(backColorPattern *gBackColorPattern)
{
    RGBBackColor(&gBackColorPattern->backColor);

    if(gBackColorPattern->backPixelPattern)
        BackPixPat(gBackColorPattern->backPixelPattern);
    else
        BackPat(&gBackColorPattern->backBitPattern);
}

// ***** doSetBackgroundWhite

void doSetBackgroundWhite(void)
{
    RGBColor whiteColor = { 0xFFFF, 0xFFFF, 0xFFFF };
    Pattern whitePattern;

    RGBBackColor(&whiteColor);
    GetQDGlobalsWhite(&whitePattern);
    BackPat(&whitePattern);
}

// *****
// WindowList.c
// *****

// ..... includes

#include "Lists.h"

// ..... global variables

ListHandle      gCurrentListHdl;
Str255          gStringArray[16];
TypeSelectRecord gTSStruct;
SInt16          gTSResetThreshold;
ListHandle      gTSLastListHit;

extern ListDefUPP      gListDefFunctionUPP;
extern backColorPattern gBackColorPattern;
extern Boolean         gRunningOnX;

```

```
// ***** doOpenListsWindow

void doOpenListsWindow(void)
{
    OSStatus          osError;
    Rect              contentRect = { 100,100,502,357 };
    WindowRef         windowRef;
    docStructureHandle docStrucHdl;
    ControlRef         controlRef;
    Str255             software = "\pSoftware:";
    Str255             hardware = "\pHardware:";
    SInt16             fontNum;
    Rect              textListRect, pictListRect;
    ListHandle         textListHdl, iconListHdl;
    EventTypeSpec      windowEvents[] = { { kEventClassWindow, kEventWindowDrawContent },
                                           { kEventClassWindow, kEventWindowActivated },
                                           { kEventClassWindow, kEventWindowDeactivated },
                                           { kEventClassWindow, kEventWindowClickContentRgn },
                                           { kEventClassWindow, kEventWindowClose },
                                           { kEventClassMouse, kEventMouseDown },
                                           { kEventClassKeyboard, kEventRawKeyDown } };

    // ..... open window, attach document structure, set background color/pattern

    osError = CreateNewWindow(kDocumentWindowClass,kWindowStandardHandlerAttribute,
                             &contentRect,&windowRef);
    if(osError != noErr)
        ExitToShell();

    ChangeWindowAttributes(windowRef,kWindowCloseBoxAttribute,0);
    RepositionWindow(windowRef,NULL,kWindowAlertPositionOnMainScreen);
    SetWTitle(windowRef,"\pHand Made Lists");

    if(!(docStrucHdl = (docStructureHandle) NewHandle(sizeof(docStructure))))
        ExitToShell();
    SetWRefCon(windowRef,(SInt32) docStrucHdl);

    SetPortWindowPort(windowRef);

    SetThemeWindowBackground(windowRef,kThemeBrushDialogBackgroundActive,true);
    if(!gRunningOnX)
        doSaveBackground(&gBackColorPattern);
    else
        doSetBackgroundWhite();

    // ..... create window's controls

    if(!gRunningOnX)
        CreateRootControl(windowRef,&controlRef);

    if(!((*docStrucHdl)->extractButtonHdl = GetNewControl(cExtractButton>windowRef)))
        ExitToShell();
}
```

```

if(!(controlRef = GetNewControl(cSoftwareStaticText,windowRef))
    ExitToShell();
SetControlData(controlRef,kControlEntireControl,kControlStaticTextTextTag,software[0],
    &software[1]);

if(!(controlRef = GetNewControl(cHardwareStaticText,windowRef))
    ExitToShell();
SetControlData(controlRef,kControlEntireControl,kControlStaticTextTextTag,hardware[0],
    &hardware[1]);

if(!(controlRef = GetNewControl(cGroupBox,windowRef))
    ExitToShell();

// ..... set window's font

GetFNum("\pGeneva",&fontNum);
TextFont(fontNum);
TextSize(10);

// ..... create lists, assign handles to document structure fields

SetRect(&textListRect,21,26,151,130);
SetRect(&pictListRect,169,26,236,130);

textListHdl = doCreateTextList(windowRef,textListRect,1,kSystemLDEF);
iconListHdl = doCreateIconList(windowRef,pictListRect,1,gListDefFunctionUPP);

(*docStrucHdl)->textListHdl = textListHdl;
(*docStrucHdl)->iconListHdl = iconListHdl;

// ..... assign handles to list structure refCon fields for linked ring

SetListRefCon(textListHdl,(SInt32) iconListHdl);
SetListRefCon(iconListHdl,(SInt32) textListHdl);

// ..... make text list the current list

gCurrentListHdl = textListHdl;

// ..... install window event handler

InstallWindowEventHandler(windowRef,
    NewEventHandlerUPP((EventHandlerProcPtr) windowEventHandler),
    GetEventTypeCount(windowEvents),windowEvents,0,NULL);

// ..... save and set background color/pattern, show window

ShowWindow(windowRef);
}

```

```
// ***** doKeyDown

void doKeyDown(SInt8 charCode, EventRecord * eventStrucPtr)
{
    docStructureHandle docStrucHdl;
    Boolean allowExtendSelect;

    docStrucHdl = (docStructureHandle) GetWRefCon(FrontWindow());

    if(charCode == kTab)
    {
        doRotateCurrentList();
    }
    else if(charCode == kUpArrow || charCode == kDownArrow)
    {
        if(gCurrentListHdl == (*docStrucHdl)->textListHdl)
            allowExtendSelect = true;
        else
            allowExtendSelect = false;

        doHandleArrowKey(charCode, eventStrucPtr, allowExtendSelect);
    }
    else
    {
        if(gCurrentListHdl == (*docStrucHdl)->textListHdl)
            doTypeSelectSearch((*docStrucHdl)->textListHdl, eventStrucPtr);
    }
}

// ***** doDrawContent

void doDrawContent(WindowRef windowRef)
{
    docStructureHandle docStrucHdl;
    ListHandle textListHdl, iconListHdl;
    RgnHandle visibleRegionHdl = NewRgn();

    SetPortWindowPort(windowRef);

    GetPortVisibleRegion(GetWindowPort(windowRef), visibleRegionHdl);
    UpdateControls(windowRef, visibleRegionHdl);

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    textListHdl = (*docStrucHdl)->textListHdl;
    iconListHdl = (*docStrucHdl)->iconListHdl;

    if(visibleRegionHdl)
    {
        if(gRunningOnX)
        {
            if(IsWindowHilited(windowRef))
                TextMode(srcOr);
            else
                TextMode(grayishTextOr);
        }
    }
}
```

```

    LUpdate(visibleRegionHdl,textListHdl);
    LUpdate(visibleRegionHdl,iconListHdl);
    DisposeRgn(visibleRegionHdl);
}

doDrawFrameAndFocus(textListHdl,IsWindowHilited(windowRef));
doDrawFrameAndFocus(iconListHdl,IsWindowHilited(windowRef));

doDrawSelections(windowRef == FrontWindow());
}

// ***** doActivateDeactivate

void doActivateDeactivate(WindowRef windowRef,Boolean becomingActive)
{
    GrafPtr      oldPort;
    ControlRef    controlRef;
    docStructureHandle docStrucHdl;
    ListHandle     textListHdl, iconListHdl;
    RgnHandle      visibleRegionHdl = NewRgn();

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    if(!gRunningOnX)
    {
        GetRootControl(windowRef,&controlRef);
        if(becomingActive)
            ActivateControl(controlRef);
        else
            DeactivateControl(controlRef);
    }

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);
    textListHdl = (*docStrucHdl)->textListHdl;
    iconListHdl = (*docStrucHdl)->iconListHdl;

    if(visibleRegionHdl)
        GetPortVisibleRegion(GetWindowPort(windowRef),visibleRegionHdl);

    if(becomingActive)
    {
        LActivate(true,textListHdl);
        LActivate(true,iconListHdl);

        if(!gRunningOnX)
        {
            TextMode(srcOr);
            if(visibleRegionHdl)
            {
                LUpdate(visibleRegionHdl,textListHdl);
                LUpdate(visibleRegionHdl,iconListHdl);
                DisposeRgn(visibleRegionHdl);
            }
        }
    }
}

```

```

        doDrawFrameAndFocus(textListHdl,true);
        doDrawFrameAndFocus(iconListHdl,true);

        doResetTypeSelection();

        doDrawSelections(true);
    }
    else
    {
        LActivate(false,textListHdl);
        LActivate(false,iconListHdl);

        if(!gRunningOnX)
        {
            TextMode(grayishTextOr);
            if(visibleRegionHdl)
            {
                LUpdate(visibleRegionHdl,textListHdl);
                LUpdate(visibleRegionHdl,iconListHdl);
                DisposeRgn(visibleRegionHdl);
            }
        }

        doDrawFrameAndFocus(textListHdl,false);
        doDrawFrameAndFocus(iconListHdl,false);

        doDrawSelections(false);
    }

    SetPort(oldPort);
}

// ***** doInContent

void doInContent(Point mouseLocation,UInt32 modifiers)
{
    WindowRef          windowRef;
    docStructureHandle docStrucHdl;
    Rect               textListRect, pictListRect;
    Boolean             isDoubleClick;

    windowRef = FrontWindow();
    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

    GetListViewBounds((*docStrucHdl)->textListHdl,&textListRect);
    GetListViewBounds((*docStrucHdl)->iconListHdl,&pictListRect);

    if(PtInRect(mouseLocation,&textListRect) || PtInRect(mouseLocation,&pictListRect))
    {
        if((PtInRect(mouseLocation,&textListRect) &&
            gCurrentListHdl != (*docStrucHdl)->textListHdl) ||
            (PtInRect(mouseLocation,&pictListRect) &&
            gCurrentListHdl != (*docStrucHdl)->iconListHdl))
        {
            doRotateCurrentList();
        }
    }
}

```

```

        isDoubleClick = LClick(mouseLocation,modifiers,gCurrentListHdl);
        if(isDoubleClick)
            doExtractSelections();
    }
}

// ***** doControlHit

void doControlHit(WindowRef windowRef,ControlRef controlRef,Point mouseLocation)
{
    docStructureHandle docStrucHdl;

    docStrucHdl = (docStructureHandle) GetWRefCon(windowRef);

    if(controlRef == (*docStrucHdl)->extractButtonHdl)
    {
        if(TrackControl(controlRef,mouseLocation,NULL))
            doExtractSelections();
    }
    else
    {
        if((mouseLocation.h < 165 && gCurrentListHdl != (*docStrucHdl)->textListHdl) ||
            (mouseLocation.h > 165 && gCurrentListHdl != (*docStrucHdl)->iconListHdl))
        {
            doRotateCurrentList();
        }

        LClick(mouseLocation,0,gCurrentListHdl);
    }
}

// ***** doCreateTextList

ListHandle doCreateTextList(WindowRef windowRef,Rect listRect,SInt16 numCols,SInt16 lDef)
{
    Rect    dataBounds;
    Point    cellSize;
    ListHandle textListHdl;
    Cell    theCell;

    SetRect(&dataBounds,0,0,numCols,0);
    SetPt(&cellSize,0,0);

    listRect.right = listRect.right - kScrollBarWidth;

    textListHdl = LNew(&listRect,&dataBounds,cellSize,lDef>windowRef,true,false,false,true);

    doAddRowsAndDataToTextList(textListHdl,rTextListStrings,15);

    SetPt(&theCell,0,0);
    LSetSelect(true,theCell,textListHdl);

    doResetTypeSelection();

    return textListHdl;
}

```



```
// ***** doAddRowsAndDataToTextList

void doAddRowsAndDataToTextList(ListHandle textListHdl,SInt16 stringListID,
                               SInt16 numberOfStrings)
{
    SInt16 stringIndex;
    Str255 theString;

    for(stringIndex = 1;stringIndex < numberOfStrings + 1;stringIndex++)
    {
        GetIndString(theString,stringListID,stringIndex);
        doAddTextItemAlphabetically(textListHdl,theString);
    }
}

// ***** doAddTextItemAlphabetically

void doAddTextItemAlphabetically(ListHandle listHdl,Str255 theString)
{
    Boolean    found;
    ListBounds dataBounds;
    SInt16     totalRows, currentRow, cellDataOffset, cellDataLength;
    DataHandle dataHandle;
    Cell       aCell;

    found = false;

    GetListDataBounds(listHdl,&dataBounds);
    totalRows = dataBounds.bottom - dataBounds.top;
    currentRow = -1;

    while(!found)
    {
        currentRow += 1;
        if(currentRow == totalRows)
            found = true;
        else
        {
            SetPt(&aCell,0,currentRow);
            LGetCellDataLocation(&cellDataOffset,&cellDataLength,aCell,listHdl);

            dataHandle = GetListDataHandle(listHdl);
            MoveHHi((Handle) dataHandle);
            HLock((Handle) dataHandle);

            if(CompareText(theString + 1,((Ptr) (*listHdl)->cells[0] + cellDataOffset),
                          StrLength(theString),cellDataLength,NULL) == -1)
            {
                found = true;
            }

            HUnlock((Handle) dataHandle);
        }
    }
}
```

```

    currentRow = LAddRow(1,currentRow,listHdl);
    SetPt(&aCell,0,currentRow);

    LSetCell(theString + 1,(SInt16) StrLength(theString),aCell,listHdl);
}

// ***** doCreateIconList

ListHandle doCreateIconList(WindowRef windowRef,Rect listRect,SInt16 numCols,
                           ListDefUPP listDefinitionFunctionUPP)
{
    Rect      dataBounds;
    Point     cellSize;
    ListHandle iconListHdl;
    Cell      theCell;
    ListDefSpec listDefSpec;

    SetRect(&dataBounds,0,0,numCols,0);
    SetPt(&cellSize,52,52);

    listRect.right = listRect.right - kScrollBarWidth;

    listDefSpec.u.userProc = listDefinitionFunctionUPP;

    CreateCustomList(&listRect,&dataBounds,cellSize,&listDefSpec>windowRef,true,false,false,
                    true,&iconListHdl);

    SetListSelectionFlags(iconListHdl,lOnlyOne);

    doAddRowsAndDataToIconList(iconListHdl,rIconListIconSuiteBase);

    SetPt(&theCell,0,0);
    LSetSelect(true,theCell,iconListHdl);

    return iconListHdl;
}

// ***** doAddRowsAndDataToIconList

void doAddRowsAndDataToIconList(ListHandle iconListHdl,SInt16 iconSuiteBase)
{
    ListBounds dataBounds;
    SInt16      rowNumber, suiteIndex, index = 0;
    Handle      iconSuiteHdl;
    Cell        theCell;

    GetListDataBounds(iconListHdl,&dataBounds);
    rowNumber = dataBounds.bottom;

    for(suiteIndex = iconSuiteBase;suiteIndex < (iconSuiteBase + 10);suiteIndex++)
    {
        GetIconSuite(&iconSuiteHdl,suiteIndex,kSelectorAllLargeData);
    }
}

```

```

        rowNumber = LAddRow(1,rowNumber,iconListHdl);
        SetPt(&theCell,0,rowNumber);
        LSetCell(&iconSuiteHdl,sizeof(iconSuiteHdl),theCell,iconListHdl);

        rowNumber += 1;
    }
}

// ***** doHandleArrowKey

void doHandleArrowKey(SInt8 charCode,EventRecord * eventStrucPtr,Boolean allowExtendSelect)
{
    Boolean moveToTopBottom = false;

    if(eventStrucPtr->modifiers & cmdKey)
        moveToTopBottom = true;

    if(allowExtendSelect && (eventStrucPtr->modifiers & shiftKey))
        doArrowKeyExtendSelection(gCurrentListHdl,charCode,moveToTopBottom);
    else
        doArrowKeyMoveSelection(gCurrentListHdl,charCode,moveToTopBottom);
}

// ***** doArrowKeyMoveSelection

void doArrowKeyMoveSelection(ListHandle listHdl,SInt8 charCode,Boolean moveToTopBottom)
{
    Cell currentSelection, newSelection;

    if(doFindFirstSelectedCell(listHdl,&currentSelection))
    {
        if(charCode == kDownArrow)
            doFindLastSelectedCell(listHdl,&currentSelection);

        doFindNewCellLoc(listHdl,currentSelection,&newSelection,charCode,moveToTopBottom);

        doSelectOneCell(listHdl,newSelection);
        doMakeCellVisible(listHdl,newSelection);
    }
}

// ***** doArrowKeyExtendSelection

void doArrowKeyExtendSelection(ListHandle listHdl,SInt8 charCode,Boolean moveToTopBottom)
{
    Cell currentSelection, newSelection;

    if(doFindFirstSelectedCell(listHdl,&currentSelection))
    {
        if(charCode == kDownArrow)
            doFindLastSelectedCell(listHdl,&currentSelection);

        doFindNewCellLoc(listHdl,currentSelection,&newSelection,charCode,moveToTopBottom);
    }
}

```

```

        if(!(LGetSelect(false,&newSelection,listHdl)))
            LSetSelect(true,newSelection,listHdl);

        doMakeCellVisible(listHdl,newSelection);
    }
}

// ***** doTypeSelectSearch

void doTypeSelectSearch(ListHandle listHdl,EventRecord * eventStrucPtr)
{
    Cell          theCell;
    ListSearchUPP searchPartialMatchUPP;

    if((gTSLastListHit != listHdl) || ((eventStrucPtr->when - gTSStruct.tsrLastKeyTime) >=
        gTSResetThreshold) || (StrLength(gTSStruct.tsrKeyStrokes) == 63))
        doResetTypeSelection();

    gTSLastListHit = listHdl;
    gTSStruct.tsrLastKeyTime = eventStrucPtr->when;

    TypeSelectNewKey(eventStrucPtr,&gTSStruct);

    SetPt(&theCell,0,0);

    searchPartialMatchUPP = NewListSearchUPP((ListSearchProcPtr) searchPartialMatch);

    if(LSearch(gTSStruct.tsrKeyStrokes + 1,StrLength(gTSStruct.tsrKeyStrokes),
        searchPartialMatchUPP,&theCell,listHdl))
    {
        LSetSelect(true,theCell,listHdl);
        doSelectOneCell(listHdl,theCell);
        doMakeCellVisible(listHdl,theCell);
    }

    DisposeListSearchUPP(searchPartialMatchUPP);
}

// ***** searchPartialMatch

SInt16 searchPartialMatch(Ptr searchDataPtr,Ptr cellDataPtr,SInt16 cellDataLen,
                        SInt16 searchDataLen)
{
    SInt16 result;

    if((cellDataLen > 0) && (cellDataLen >= searchDataLen))
        result = IdenticalText(cellDataPtr,searchDataPtr,searchDataLen,searchDataLen,NULL);
    else
        result = 1;

    return result;
}

```

```

// ***** doFindFirstSelectedCell

Boolean doFindFirstSelectedCell(ListHandle listHdl, Cell *theCell)
{
    Boolean result;

    SetPt(theCell, 0, 0);
    result = LGetSelect(true, theCell, listHdl);

    return result;
}

// ***** doFindLastSelectedCell

void doFindLastSelectedCell(ListHandle listHdl, Cell *theCell)
{
    Cell    aCell;
    Boolean moreCellsInList;

    if(doFindFirstSelectedCell(listHdl, &aCell))
    {
        while(LGetSelect(true, &aCell, listHdl))
        {
            *theCell = aCell;
            moreCellsInList = LNextCell(true, true, &aCell, listHdl);
        }
    }
}

// ***** doFindNewCellLoc

void doFindNewCellLoc(ListHandle listHdl, Cell oldCellLoc, Cell *newCellLoc, SInt8 charCode,
                     Boolean moveToTopBottom)
{
    ListBounds dataBounds;
    SInt16     listRows;

    GetListDataBounds(listHdl, &dataBounds);
    listRows = dataBounds.bottom - dataBounds.top;
    *newCellLoc = oldCellLoc;

    if(moveToTopBottom)
    {
        if(charCode == kUpArrow)
            (*newCellLoc).v = 0;
        else if(charCode == kDownArrow)
            (*newCellLoc).v = listRows - 1;
    }
    else
    {
        if(charCode == kUpArrow)
        {
            if(oldCellLoc.v != 0)
                (*newCellLoc).v = oldCellLoc.v - 1;
        }
    }
}

```

```

    else if(charCode == kDownArrow)
    {
        if(oldCellLoc.v != listRows - 1)
            (*newCellLoc).v = oldCellLoc.v + 1;
    }
}

// ***** doSelectOneCell

void doSelectOneCell(ListHandle listHdl,Cell theCell)
{
    Cell    nextSelectedCell;
    Boolean moreCellsInList;

    if(doFindFirstSelectedCell(listHdl,&nextSelectedCell))
    {
        while(LGetSelect(true,&nextSelectedCell,listHdl))
        {
            if(nextSelectedCell.v != theCell.v)
                LSetSelect(false,nextSelectedCell,listHdl);
            else
                moreCellsInList = LNextCell(true,true,&nextSelectedCell,listHdl);
        }

        LSetSelect(true,theCell,listHdl);
    }
}

// ***** doMakeCellVisible

void doMakeCellVisible(ListHandle listHdl,Cell newSelection)
{
    ListBounds visibleRect;
    SInt16      dRows;

    GetListVisibleCells(listHdl,&visibleRect);

    if(!(PtInRect(newSelection,&visibleRect)))
    {
        if(newSelection.v > visibleRect.bottom - 1)
            dRows = newSelection.v - visibleRect.bottom + 1;
        else if(newSelection.v < visibleRect.top)
            dRows = newSelection.v - visibleRect.top;

        LScroll(0,dRows,listHdl);
    }
}

// ***** doResetTypeSelection

void doResetTypeSelection(void)
{
    TypeSelectClear(&gTSStruct);
    gTSLastListHit = NULL;
}

```

```

    gTSResetThreshold = 2 * LMGetKeyThresh();
    if(gTSResetThreshold > kMaxKeyThresh)
        gTSResetThreshold = kMaxKeyThresh;
}

// ***** doRotateCurrentList

void doRotateCurrentList(void)
{
    ListHandle oldListHdl, newListHdl;

    oldListHdl = gCurrentListHdl;

    newListHdl = (ListHandle) GetListRefCon(gCurrentListHdl);
    gCurrentListHdl = newListHdl;

    doDrawFrameAndFocus(oldListHdl,true);
    doDrawFrameAndFocus(newListHdl,true);
}

// ***** doDrawFrameAndFocus

void doDrawFrameAndFocus(ListHandle listHdl,Boolean inState)
{
    Rect borderRect;

    GetListViewBounds(listHdl,&borderRect);
    borderRect.right += kScrollBarWidth;

    if(!gRunningOnX)
        doRestoreBackground(&gBackColorPattern);
    else
        InvalWindowRect(FrontWindow(),&borderRect);

    DrawThemeFocusRect(&borderRect,false);

    if(inState)
        DrawThemeListBoxFrame(&borderRect,kThemeStateActive);
    else
        DrawThemeListBoxFrame(&borderRect,kThemeStateInactive);

    if(listHdl == gCurrentListHdl)
        DrawThemeFocusRect(&borderRect,inState);

    if(!gRunningOnX)
        doSetBackgroundWhite();
}

// ***** doExtractSelections

void doExtractSelections(void)
{
    docStructureHandle docStrucHdl;
    ListHandle          textListHdl, iconListHdl;

```

```

SInt16      a, cellIndex, offset, dataLen;
ListBounds  dataBounds;
Cell        theCell;
Rect        theRect;

docStrucHdl = (docStructureHandle) GetWRefCon(FrontWindow());
textListHdl = (*docStrucHdl)->textListHdl;
iconListHdl = (*docStrucHdl)->iconListHdl;

for(a=0;a<16;a++)
    gStringArray[a][0] = 0;

GetListDataBounds(textListHdl,&dataBounds);

for(cellIndex = 0;cellIndex < dataBounds.bottom;cellIndex++)
{
    SetPt(&theCell,0,cellIndex);
    if(LGetSelect(false,&theCell,textListHdl))
    {
        LGetCellDataLocation(&offset,&dataLen,theCell,textListHdl);
        LGetCell(gStringArray[cellIndex] + 1,&dataLen,theCell,textListHdl);
        gStringArray[cellIndex][0] = (SInt8) dataLen;
    }
}

SetPt(&theCell,0,0);
LGetSelect(true,&theCell,iconListHdl);
GetIndString(gStringArray[15],rIconListStrings,theCell.v + 1);

SetRect(&theRect,24,181,233,380);
InvalWindowRect(FrontWindow(),&theRect);
}

// ***** doDrawSelections *****

void doDrawSelections(Boolean inState)
{
    Rect        theRect;
    SInt16      a, nextLine = 190;
    CFStringRef stringRef;

    if(inState == kThemeStateActive)
        TextMode(srcOr);
    else
        TextMode(grayishTextOr);

    SetRect(&theRect,22,179,235,382);
    EraseRect(&theRect);

    for(a=0;a<15;a++)
    {
        if(gStringArray[a][0] != 0)
        {
            stringRef = CFStringCreateWithPascalString(NULL,gStringArray[a],
                kCFStringEncodingMacRoman);

```



```

        SetRect(&theRect,36,nextLine,240,nextLine + 15);
        DrawThemeTextBox(stringRef,kThemeSmallSystemFont,0,false,&theRect,teJustLeft,
                        NULL);
        nextLine += 12;
    }
}

stringRef = CFStringCreateWithPascalString(NULL,gStringArray[15],
                                           kCFStringEncodingMacRoman);
SetRect(&theRect,170,190,240,205);
DrawThemeTextBox(stringRef,kThemeSmallSystemFont,0,false,&theRect,teJustLeft,
                NULL);

TextMode(srcOr);
}

// ***** listDefFunction

void listDefFunction(SInt16 message,Boolean selected,Rect *cellRect,Cell theCell,
                    SInt16 dataOffset,SInt16 dataLen,ListHandle theList)
{
    switch(message)
    {
        case lDrawMsg:
            doLDEFDraw(selected,cellRect,theCell,dataLen,theList);
            break;

        case lHiliteMsg:
            doLDEFHighlight(cellRect);
            break;
    }
}

// ***** doLDEFDraw

void doLDEFDraw(Boolean selected,Rect *cellRect,Cell theCell,SInt16 dataLen,
                ListHandle theList)
{
    GrafPtr oldPort;
    Rect drawRect;
    Handle iconSuiteHdl;
    Str255 theString;

    GetPort(&oldPort);

    SetPort(GetListPort(theList));

    EraseRect(cellRect);

    drawRect = *cellRect;

    drawRect.top += 2;
    drawRect.left += 10;
    drawRect.right -= 10;
    drawRect.bottom -= 18;

```

```

if(dataLen == sizeof(Handle))
{
    LGetCell(&iconSuiteHdl,&dataLen,theCell,theList);

    if(GetListActive(theList))
        PlotIconSuite(&drawRect,kAlignNone,kTransformNone,iconSuiteHdl);
    else
        PlotIconSuite(&drawRect,kAlignNone,kTransformDisabled,iconSuiteHdl);
}

GetIndString(theString,129,theCell.v + 1);
SetRect(&drawRect,drawRect.left - 10,drawRect.top + 36,drawRect.right + 10,
        drawRect.bottom + 16);
TETextBox(&theString[1],theString[0],&drawRect,teCenter);

if(selected)
    doLDEFHighlight(cellRect);

SetPort(oldPort);
}

// ***** doLDEFHighlight

void doLDEFHighlight(Rect *cellRect)
{
    UInt8 hiliteVal;

    hiliteVal = LMGetHiliteMode();
    BitClr(&hiliteVal,pHiliteBit);
    LMSetHiliteMode(hiliteVal);

    InvertRect(cellRect);
}

// *****
// DialogLists.c CLASSIC EVENT MODEL
// *****

// ..... includes

#include "Lists.h"

// ***** doListsDialog

void doListsDialog(void)
{
    DialogPtr    dialogPtr;
    GrafPtr      oldPort;
    ModalFilterUPP eventFilterUPP;
    ControlRef    dateFormatControlRef, watermarkControlRef, controlRef;
    ListHandle    dateFormatListHdl, watermarkListHdl;
    SInt16        itemHit;
    Cell          theCell;
    SInt16        dataLen, offset;
    Str255        dateFormatString, watermarkString;
    Boolean        wasDoubleClick = false;

```

```

// ..... explicitly deactivate front window if it exists, create dialog

if(FrontWindow())
    doActivateDeactivate(FrontWindow(),false);

if(!(dialogPtr = GetNewDialog(rListsDialog,NULL,(WindowRef) -1)))
    ExitToShell();

GetPort(&oldPort);
SetPortDialogPort(dialogPtr);

// ..... set default push button

SetDialogDefaultItem(dialogPtr,kStdOkItemIndex);

// ..... create universal procedure pointer for event filter function

eventFilterUPP = NewModalFilterUPP((ModalFilterProcPtr) eventFilter);

// ..... add rows to lists, store data in their cells, modify cell selection algorithm

GetDialogItemAsControl(dialogPtr,iDateFormatList,&dateFormatControlRef);
GetControlData(dateFormatControlRef,kControlEntireControl,kControlListBoxListHandleTag,
    sizeof(dateFormatListHdl),&dateFormatListHdl,NULL);

doAddRowsAndDataToTextList(dateFormatListHdl,rDateFormatStrings,17);

SetListSelectionFlags(dateFormatListHdl,lOnlyOne);

SetPt(&theCell,0,0);
LSetSelect(true,theCell,dateFormatListHdl);

GetDialogItemAsControl(dialogPtr,iWatermarkList,&watermarkControlRef);
GetControlData(watermarkControlRef,kControlEntireControl,kControlListBoxListHandleTag,
    sizeof(watermarkListHdl),&watermarkListHdl,NULL);

doAddRowsAndDataToTextList(watermarkListHdl,rWatermarkStrings,12);

SetListSelectionFlags(watermarkListHdl,lOnlyOne);

SetPt(&theCell,0,0);
LSetSelect(true,theCell,watermarkListHdl);

// ..... show dialog and set keyboard focus

ShowWindow(GetDialogWindow(dialogPtr));

SetKeyboardFocus(GetDialogWindow(dialogPtr),dateFormatControlRef,1);

// ..... enter ModalDialog loop

do
{
    ModalDialog(eventFilterUPP,&itemHit);

```

```

if(itemHit == iDateFormatList)
{
    SetPt(&theCell,0,0);
    LGetSelect(true,&theCell,dateFormatListHdl);
    LGetCellDataLocation(&offset,&dataLen,theCell,dateFormatListHdl);
    LGetCell(dateFormatString + 1,&dataLen,theCell,dateFormatListHdl);
    dateFormatString[0] = (SInt8) dataLen;

    GetDialogItemAsControl(dialogPtr,iDateFormatStaticText,&controlRef);
    SetControlData(controlRef,kControlEntireControl,kControlStaticTextTextTag,
        dateFormatString[0],&dateFormatString[1]);
    Draw1Control(controlRef);

    GetControlData(dateFormatControlRef,kControlEntireControl,
        kControlListBoxDoubleClickTag,sizeof(wasDoubleClick),&wasDoubleClick,
        NULL);
}
else if(itemHit == iWatermarkList)
{
    SetPt(&theCell,0,0);
    LGetSelect(true,&theCell,watermarkListHdl);
    LGetCellDataLocation(&offset,&dataLen,theCell,watermarkListHdl);
    LGetCell(watermarkString + 1,&dataLen,theCell,watermarkListHdl);
    watermarkString[0] = (SInt8) dataLen;

    GetDialogItemAsControl(dialogPtr,iWatermarkStaticText,&controlRef);
    SetControlData(controlRef,kControlEntireControl,kControlStaticTextTextTag,
        watermarkString[0],&watermarkString[1]);
    Draw1Control(controlRef);

    GetControlData(watermarkControlRef,kControlEntireControl,
        kControlListBoxDoubleClickTag,sizeof(wasDoubleClick),&wasDoubleClick,
        NULL);
}

} while(itemHit != kStdOkItemIndex && wasDoubleClick == false);

// ..... clean up

DisposeDialog(dialogPtr);
DisposeModalFilterUPP(eventFilterUPP);
SetPort(oldPort);
}

// ***** eventFilter

Boolean eventFilter(DialogPtr dialogPtr,EventRecord *eventStrucPtr,SInt16 *itemHit)
{
    Boolean    handledEvent;
    GrafPtr    oldPort;
    SInt8      charCode;
    ControlRef controlRef, focusControlRef;
    ListHandle watermarkListHdl;

```

```

handledEvent = false;
GetPort(&oldPort);
SetPortDialogPort(dialogPtr);

if(eventStrucPtr->what == keyDown)
{
    charCode = eventStrucPtr->message & charCodeMask;

    if(charCode != kUpArrow && charCode != kDownArrow && charCode != kTab)
    {
        GetDialogItemAsControl(dialogPtr,iWatermarkList,&controlRef);
        GetControlData(controlRef,kControlEntireControl,kControlListBoxListHandleTag,
            sizeof(watermarkListHdl),&watermarkListHdl,NULL);
        GetKeyboardFocus(GetDialogWindow(dialogPtr),&focusControlRef);
        if(controlRef == focusControlRef)
        {
            doTypeSelectSearch(watermarkListHdl,eventStrucPtr);
            Draw1Control(controlRef);
        }

        handledEvent = true;
    }
}
else
{
    handledEvent = StdFilterProc(dialogPtr,eventStrucPtr,itemHit);
}

SetPort(oldPort);
return handledEvent;
}

// *****

```

## Demonstration Program Lists Comments

When this program is run, the user should open the window and movable modal dialog by choosing the relevant items in the Demonstration menu. The user should manipulate the lists in the window and dialog, noting their behavior in the following circumstances:

- Changing the active list (that is, the current target of mouse and keyboard activity) by clicking in the nonactive list and by using the Tab key to cycle between the two lists.
- Scrolling the active list using the vertical scroll bars, including dragging the scroll box/scroller and clicking in the scroll arrows and gray areas/track.
- Clicking, and clicking and dragging, in the active list so as to select a particular cell, including dragging the cursor above and below the list to automatically scroll the list to the desired cell.

- Pressing the Up-Arrow and Down-Arrow keys, noting that this action changes the selected cell and, where necessary, scrolls the list to make the newly selected cell visible.
- In the lists in the window
  - Double-clicking on a cell in the active list.
  - Pressing the Command-key as well as the Up-Arrow and Down-Arrow keys, noting that, in both the text list and the picture list, this results in the top-most or bottom-most cell being selected.
- In the “Software” list in the window
  - Shift-clicking and dragging in the list to make contiguous multiple cell selections.
  - Command-clicking and dragging in the list to make noncontiguous multiple cell selections, noting the differing effects depending on whether the cell initially clicked is selected or not selected.
  - Shift-clicking outside a block of multiple cell selections, including between two fairly widely separated noncontiguous selected cells.
  - Pressing the Shift-key as well as the Up-Arrow and Down-Arrow keys, noting that this results in multiple cell selections.
  - When the text list in the window, or the right hand list in the dialog, is the active list, typing the text of a particular cell so as to select that cell by type selection, noting the effects of any excessive delay between keystrokes.

The user should also send the program to the background and bring it to the foreground again, noting the list deactivation/activation effects.

## Lists.h

### defines

`rListsDialog` represents the resource ID of the dialog's 'DLOG' resource. `CExtractButton` and the following three constants represent the resource IDs of the window's controls. The next three constants represent the resource IDs of resources containing the strings for the window's text list, the icon suite for the icon list, and the strings for the icon titles.

`rListsDialog` represents the resource ID of the dialog's 'DLOG', 'dlgx', and 'dftb' resources. The following four constants represent the item numbers of items in the dialog's 'DITL' resource. The next two constants represent the resource IDs of the 'STR#' resources containing the strings for the dialog's lists.

The next three constants represent the character codes returned by the Up Arrow, Down Arrow, and Tab keys. `kScrollBarWidth` represents the width of the lists' vertical scroll bars.

`kMaxKeyThresh` is used in the type selection function. `kSystemLDEF` represents the resource ID of the default list definition function.

### **typedefs**

The type `docStructure` will be used to store the handles to the two list structures for the window and the reference to the window's push button. The handle to this structure will be stored in the window object.

The `backColorPattern` data type will be used to save and restore the background color and pattern.

### **Lists.c**

`Lists.c` is simply the basic “engine” that supports the demonstration. There is little in this file that has not featured in previous demonstration programs.

### **main**

A universal procedure pointer is created for the custom list definition function used by the second list in the window.

### **windowEventHandler**

When the `kEventWindowClickContentRgn` event type is received, `doInContent` is called. The mouse location in local coordinates and the modifier keys are passed in the call.

When the `kEventWindowClose` event type is received, a handle to the window's document structure is retrieved so as to be able to pass the handles to the window's two list structures in the two calls to `LDispose`. `LDispose` disposes of all memory associated with the specified list.

When the `kEventRawKeyDown` event type is received, `doKeyDown` is called with the address of a variable of type `EventRecord` passed in the second parameter. Note that, in the case of this particular event type, the function `ConvertEventRefToEventRecord` does not “fill in” the event record's what, message, and modifiers fields. Accordingly, in lieu of a call to `ConvertEventRefToEventRecord`, the character code and modifiers are extracted from the event and a fully fleshed-out event record is constructed by the program prior to the call to `doKeyDown`.

### **doSaveBackground, doRestoreBackground, and doSetBackgroundWhite**

`doSaveBackground` and `doRestoreBackground` save and restore the background color and the background bit or pixel pattern, and are called only when the program is run on Mac OS 8/9. `doSetBackgroundWhite` sets the background color to white and the background pattern to the pattern white.

### **WindowList.c**

`WindowList.c` contains the functions pertaining to the lists in the window.



## Global Variables

`gCurrentListHandle` will be assigned the handle to the list structure associated with the currently active list in the window. `gStringArray` will be assigned strings representing the selections from the lists. The next three global variables are associated with the type selection functions.

## doOpenListsWindow

`doOpenListsWindow` creates the window and its controls, and calls the functions that create the two lists for the window.

`SetThemeWindowBackground` is called to set the window's background color/pattern and, if the program is running on Mac OS 8/9, `doSaveBackground` is called to save this background color/pattern for later use in the function `doDrawFrameAndFocus`. The call to `doSetBackgroundWhite` at this point is required only on Mac OS X to ensure that the background within the list frames is drawn in white.

`CreateRootControl` creates a root control for the window so as to simplify the task of activating and deactivating the window's controls. (This call is not required on Mac OS X because, on Mac OS X, the root control will be created automatically for windows which have at least one control.) The window's remaining controls are then created.

The calls to `doCreateTextList` and `doCreateIconList` create the lists. First, the rectangles in which the lists are to be displayed are defined. These are then passed in the calls to `doCreateTextList` and `doCreateIconList`. The handles to the list structures returned by these functions are then assigned to the relevant fields of the window's document structure.

The next block assigns the icon list's handle to the `refCon` field of the text list's list structure and the text list's handle to the `refCon` field of the icon list's list structure. This establishes the "linked ring" which will be used to facilitate the rotation of the active list via Tab key presses.

The next line establishes the text list as the currently active list.

## doKeyDown

The first line gets the handle to the document structure.

If the key pressed was the Tab key, `doRotateCurrentList` is called to change the currently active list.

If the key pressed was either the Up Arrow or the Down Arrow key, and if the current list is the text list, a variable that specifies whether multiple cell selections via the keyboard are permitted is set to `true`. If the current list is the icon list, this variable is set to `false`. This variable is then passed as a parameter in a call to `doHandleArrowKey`, which further processes the Arrow key event.



If the key pressed was neither the Tab key, the Up Arrow key, or the Down Arrow key, and if the active list is the text list, the event is passed to `doTypeSelectSearch` (the type selection function) for further processing.

### **doDrawContent**

`doDrawContent` is called when the `kEventWindowDrawContent` event type is received. The calls to `LUpdate` update (that is, redraw) the lists and the calls to `doDrawFrameAndFocus` draw the focus rectangles in the appropriate state. The call to `doDrawSelections` simply draws the current list selections in the rectangle at the bottom of the window.

The calls to `TextMode` if the program is running on Mac OS X are required because of certain machinations in the function `doDrawFrameAndFocus`.

### **doActivateDeactivate**

`doActivateDeactivate` is called when the `kEventWindowActivated` and `kEventWindowDeactivated` event types are received.

If the program is running on Mac OS 8/9 the root control is activated or deactivated, as appropriate, thus activating or deactivating all the controls in the window. (This is done automatically on Mac OS X.)

If the window is becoming active, the following occurs. For both lists, `LActivate` is called with `true` passed in the first parameter so as to highlight the currently selected cells. The calls to `TextMode` and `LUpdate` when the program is running on Mac OS 8/9 are required for cosmetic purposes only. `LUpdate` causes a redraw of all of the list's text in the `srcOr` mode. The calls to `doDrawFrameAndFocus` draw the list box frames in the active state and ensure that a keyboard focus frame is redrawn around the currently active list. The call to `doResetTypeSelection` resets certain variables used by the type selection function. (This latter is necessary because it is possible that, while the application was in the background, the user may have changed the Delay Until Repeat setting in the Keyboard control panel (Mac OS 8/9) or System Preferences/Keyboard (Mac OS X), a value which is used in the type selection function.) `doDrawSelections` redraws the current list selections in the `srcOr` mode.

Except for the call to `doResetTypeSelection`, much the same occurs if the window is becoming inactive, except that `LActivate` removes highlighting from the currently selected cells, `LUpdate` redraws the lists' text in the `grayishTextOr` mode (on Mac OS 8/9), `doDrawFrameAndFocus` removes the keyboard focus frame from the active list and draws the list box frames in the inactive state, and `doDrawSelections` redraws the current list selections in the `grayishTextOr` mode.

### **doInContent**

`doInContent` is called when the `kEventWindowClickContentRgn` event type is received. Note that the mouse location received in the `mouseLocation` formal parameter is in local coordinates.

The calls to `GetListViewBounds` get the lists' display rectangles.

If the mouse click was in one of the list rectangles, and if that rectangle is not the current list's rectangle, `doRotateCurrentList` is called to change the currently active list. Next, `LClick` is called to handle all user action until the mouse-button is released. If `LClick` returns true, a double-click occurred, in which case `doExtractSelections` is called to extract and display the contents of the currently selected cells.

### **doControlHit**

`doControlHit` is called when the `kEventMouseDown` event type is received and a call to `FindControlUnderMouse` reports that there is a control under the mouse cursor.

If the control is the Extract push button, `TrackControl` is called to handle user actions until the mouse button is released. If the cursor is still within the control when the mouse button is released, `doExtractSelections` is called to extract and display the contents of the currently selected cells.

If the control is one of the lists' scroll bars, `doRotateCurrentList` is called to change the currently active list. (This is necessary because the function `doInContent` only responds to clicks in the lists' display rectangles, which exclude the scroll bars.) `LClick` is then called to handle user interaction with the scroll bar.

### **doCreateTextList**

`doCreateTextList`, supported by the two following functions, creates the text list.

`SetRect` sets the rectangle which will be passed as the `rDataBnds` parameter of the `LNew` call to specify one column and (initially) no rows. `SetPt` sets the variable that will be passed as the `cellSize` parameter so as to specify that the List Manager should automatically calculate the cell size. The next line adjusts the received list rectangle to eliminate the area occupied by the vertical scroll bar.

The call to `LNew` creates the list. The parameters specify that the List Manager is to calculate the cell size, the default list definition function is to be used, automatic drawing mode is to be enabled, no room is to be left for a size box, the list is not to have a horizontal scroll bar, and the list is to have a vertical scroll bar.

The call to `doAddRowsAndDataToTextList` adds rows to the list and stores data in its cells.

The next two lines set the cell at the topmost row as the initially selected cell.

`doResetTypeSelection` calls a function which initializes certain variables used by the type selection function. The last line returns the handle to the list.

### **doAddRowsAndDataToTextList**

`doAddRowsAndDataToTextList` adds rows to the text list and stores data in its cells. The data is retrieved from a 'STR#' resource.

The for loop copies the strings from the specified 'STR#' resource and passes each string as a parameter in a call to `doAddTextItemsAlphabetically`, which inserts a new row into the list and copies the string to that cell.

Note at this point that the strings in the 'STR#' resource are not arranged alphabetically.

### **doAddTextItemAlphabetically**

`doAddTextItemAlphabetically` does the heavy work in the process of adding the rows to the text list and storing the text. The bulk of the code is concerned with building the list in such a way that the cells are arranged in alphabetical order.

The first line sets the variable `found` to false. The next line sets the variable `totalRows` to the number of rows in the list. (In this program, this is initially 0.) The next line sets the variable `currentRow` to -1.

The while loop executes until the variable `found` is set to true.

Within the loop, the first line increments `currentRow` to 0. The first time this function is called, `currentRow` will equal `totalRows` at this point and the loop will thus immediately exit to the first line below the loop. The call to `LAddRow` at this line adds one row to the list, inserting it before the row specified by `currentRow`. The list now has one row (cell (0,0)). `LSetCell` copies the string to this cell. The function then exits, to be re-called by `doAddRowsAndDataToTextList` for as many times as there are remaining strings.

The second time the function is called, the first line in the while loop again sets `currentRow` to 0. This time, however, the if block does not execute because `totalRows` is now 1. Thus `SetPt` sets the variable `aCell` to (0,0) and `LGetCellDataLocation` retrieves the offset and length of the data in cell (0,0). This allows the string in this cell to be alphabetically compared with the “incoming” string using `CompareText`. If the incoming string is “less than” the string in cell (0,0), `CompareText` returns -1, in which case

- The loop exits. `LAddRow` inserts one row before cell(0,0) and the old cell (0,0) thus becomes cell(0,1). The list now contains two rows.
- `SetPt` sets cell (0,0) and `LSetCell` copies the “incoming” string to that cell. The “incoming” string, which was alphabetically “less than” the first string, is thus assigned to the correct cell in the alphabetical sense.

- The function then exits, to be called again for as many times as there are remaining strings.

If, on the other hand, `CompareText` returns 0 (strings equal) or 1 (“incoming” string “greater than” the string in cell (0,0)), the loop repeats. At the first line in the loop, `currentRow` is incremented to 1, which is equal to `totalRows`. Accordingly, the loop exits immediately, `LAddRow` inserts a row before cell (0,1) (that is, cell (0,1) is created), `LSetCell` copies the “incoming” string to that cell, and the function exits, to be called again for as many times as there are remaining strings.

The ultimate result of all this is an alphabetically ordered list.

### **doCreateIconList**

`doCreateIconList`, supported by the following function, creates the icon list. This list uses a custom list definition function; accordingly, `CreateCustomList`, rather than `LNew`, is used to create the list.

`SetRect` sets the rectangle that will be passed as the `dataBounds` parameter of the `CreateCustomList` call to specify one column and (initially) no rows. `SetPt` sets the variable that will be passed as the `cellSize` parameter so as to specify that the List Manager should make the cell size of all cells 52 by 52 pixels. The next line adjusts the list rectangle to reflect the area occupied by the vertical scroll bar. The line after that assigns the universal procedure pointer to the custom list definition function to the `userProc` field of the variable of type `ListDefSpec` that will be passed in the `theSpec` parameter of the `CreateCustomList` call.

The call to `CreateCustomList` creates the list. The parameters specify that the List Manager is to make all cell sizes 52 by 52 pixels, a custom list definition function is to be used, automatic drawing mode is to be enabled, no room is to be left for a size box, the list is not to have a horizontal scroll bar, and the list is to have a vertical scroll bar.

The next line assigns `lOnlyOne` to the `selFlags` field of the list structure, meaning that the List Manager’s cell selection algorithm is modified so as to allow only one cell to be selected at any one time.

The call to `doAddRowsAndDataToIconList` adds rows to the list and stores data in its cells.

The next two lines select the cell at the topmost row as the initially selected cell. The last line returns the handle to the list.

### **doAddRowsAndDataToIconList**

`doAddRowsAndDataToIconList` adds ten rows to the icon list and stores a handle to an icon suite in each of the eight cells.

The first two lines set the variable `rowNumber` to the current number of rows, which is 0.

The for loop executes ten times. Each time through the loop, the following occurs:

- `GetIconSuite` creates a new icon suite and fills it with icons with the specified resource ID and of the types specified in the last parameter (that is, large icons only).
- `LAddRow` inserts a new row in the list at the location specified by the variable `rowNumber`. `SetPt` sets this cell and `LSetCell` stores the handle to the icon suite as the cell's data. The last line increments the variable `rowNumber`, which is passed in the `SetPt` call.

### **doHandleArrowKey**

`doHandleArrowKey` further processes Down Arrow and Up Arrow key presses. This is the first of eleven functions dedicated to the handling of key-down events.

Recall that `doHandleArrowKey`'s third parameter (`allowExtendSelect`) is set to true by the calling function (`doKeyDown`) only if the text list is the currently active list.

The first line sets the variable `moveToTopBottom` to false, which can be regarded as the default. At the next two lines, if the Command key was also down at the time of the Arrow key press, this variable is set to true.

If the text list is the currently active list and the Shift key was down, `doArrowKeyExtendSelection` is called; otherwise, `doArrowKeyMoveSelection` is called.

### **doArrowKeyMoveSelection**

`doArrowKeyMoveSelection` further processes those Arrow key presses which occurred when either list was the currently active list but the Shift key was not down. The effect of this function is to deselect all currently selected cells and to select the appropriate cell according to, firstly, which Arrow key was pressed (Up or Down) and, secondly, whether the Command key was down at the same time.

The if statement calls `doFindSelectedCell`, which searches for the first selected cell in the specified list. That function returns true if a selected cell is found, or false if the list contains no selected cells.

If true is returned by that call, the variable `currentSelection` will hold the first selected cell. However, this could be changed by the second line within the if block if the key pressed was the Down-Arrow. `doFindLastSelectedCell` finds the last selected cell (which could, of course, be the same cell as the first selected cell if only one cell is currently selected). Either way, the variable `currentSelection` will now hold either the only cell currently selected, the first cell selected (if more than one cell is currently selected and the key pressed was the Up Arrow), or the last cell selected (if more than one cell is currently selected and the key pressed was the Down Arrow).

With that established, `doFindNewCellLoc` determines the next cell to select, which will depend whether the Command key was down at the time of the key press (that is, on whether the



`moveToTopBottom` parameter is true or false). The variable `newSelection` will contain the results of that determination.

`doSelectOneCell` then deselects all currently selected cells and selects the cell specified by the variable `newSelection`.

It is possible that the newly selected cell will be outside the list's display rectangle. Accordingly, `doMakeCellVisible`, if necessary, scrolls the list until the newly selected cell appears at the top or the bottom of the display rectangle.

### **doArrowKeyExtendSelection**

`doArrowKeyExtendSelection` is similar to the previous function except that it adds additional cells to the currently selected cells. This function is called only when the text list is the currently active list and the Shift key was down at the time of the Arrow key press.

By the fifth line, the variable `currentSelection` will hold either the only cell currently selected, the first cell selected (if more than one cell is currently selected and the key pressed was the Up Arrow), or the last cell selected (if more than one cell is currently selected and the key pressed was the Down Arrow).

`doFindNewCellLoc` determines the next cell to select, which will depend on whether the Command key was down at the time of the key press (that is, on whether the `moveToTopBottom` parameter is true or false). The variable `newSelection` will contain the results of that determination. The similarities between this function and `doArrowKeyMoveSelection` end there.

At the next line, `LGetSelect` is called to check whether the cell specified by the variable `newSelection` is selected. If it is not, `LSetSelect` selects it. (This check by `LGetSelect` is advisable because, for example, the first-selected cell as this function is entered might be cell (0,0)—that is, the very top row. If the Up-Arrow was pressed in this circumstance `doFindNewCellLoc` returns cell (0,0) in the `newSelection` variable. There is no point in selecting a cell that is already selected.)

It is possible that the newly selected cell will be outside the list's display rectangle. Accordingly, `doMakeCellVisible`, if necessary, scrolls the list until the newly selected cell appears at the top or the bottom of the display rectangle.

### **doTypeSelectSearch**

`doTypeSelectSearch` is the main type selection function. It is called from `doKeyDown` whenever the key pressed is not the Tab key, the Up Arrow key or the Down Arrow key.

The global variables `gTSstruct`, `gTSResetThreshold`, and `gTSLastListHit` are central to the operation of `doTypeSelectSearch`. `gTSstruct` holds the current type selection search string entered by the user and the time in ticks of the last key press. `gTSResetThreshold` holds the number of ticks which must elapse before type selection resets, and is dependent on the value

the user sets in the Delay Until Repeat setting in the Keyboard control panel (Mac OS 8/9) or System Preferences/Keyboard (Mac OS X). `gTSLastListHit` holds a handle to the last list that type selection affected.

The first block will cause `doResetTypeSelection`, which resets type selection, to be called if either of the following situations prevail: if the list that is the target of the current key press is not the same as the list that was the target of the previous key press; if a number of ticks since the last key press is greater than the number stored in `gTSResetThreshold`; if the current length of the type selection string is 63 characters.

The next line stores the handle to the list which is the target of the current key press in `gTSLastListHit` so as to facilitate the comparison at the first if block the next time the function is called. The next line stores the time of the current key press in `gTSLastKeyTime` for the same purpose.

The call to `TypeSelectNewKey` extracts the character code from the message field of the event structure and adds the character to the `tsrKeyStrokes` field of `gTSStruct`. That field now holds all the characters received since the last type selection reset.

`SetPt` sets the variable `theCell` to represent the first cell in the list. This is passed as a parameter in the `LSearch` call, and specifies the first cell to examine. `LSearch` examines this cell and all subsequent cells in an attempt to find a match to the type selection string. If a match exists, the cell in which the first match is found will be returned in the `theCell` parameter, `LSearch` will return true and the following three lines will execute.

Of those three lines, ordinarily only the call to `LSetSelect` (which deselects all currently selected cells and selects the specified cell) and the last line (which, if necessary, scrolls the list so that the newly selected cell is visible in the display rectangle) would be necessary. However, because the function `doSelectOneCell` has no effect unless there is currently at least one selected cell in the list, the call to `doSelectOneCell` is included to account for the situation where the user may have deselected all of the text list cells using Command-clicking or dragging.

The actual matching task is performed by the `match` (callback) function the universal procedure pointer to which is passed in the third parameter to the `LSearch` call. Note that the default match function has been replaced by the custom callback function `doSearchPartialMatch`.

### **doSearchPartialMatch**

`doSearchPartialMatch` is the custom match function called by `LSearch`, in the previous function, to attempt to find a match to the current type selection string. For the default function to return a match, the type selection string would have to match an entire cell's text.

`doSearchPartialMatch`, however, only compares the characters of the type selection string with the same number of characters in the cell's text. For example, if the type selection string

is currently “fr” and a cell with the text “Fractal Painter” exists, `doSearchPartialMatch` will report a match.

A comparison by `IdenticalText` (which returns 0 if the strings being compared are equal) is only made if the cell contains data and the length of that data is greater than or equal to the current length of the type selection string. If these conditions do not prevail, `doSearchPartialMatch` returns 1 (no match found). If these conditions do prevail, `IdenticalText` is called with, importantly, both the third and fourth parameters set to the current length of the type selection string. `IdenticalText` will return 0 if the strings match or 1 if they do not match.

### **doFindFirstSelectedCell**

`doFindFirstSelectedCell` and the following four functions are general utility functions called by the previous Arrow key handling and type selection functions. `doFindFirstSelectedCell` searches for the first selected cell in a list, returning true if a selected cell is found and providing the cell’s coordinates to the calling function.

`SetPt` sets the starting cell for the `LGetSelect` call. Because the first parameter in the `LGetSelect` call is set to true, `LGetSelect` will continue to search the list until a selected cell is found or until all cells have been examined.

`doFindFirstSelectedCell` returns true when and if a selected cell is found.

### **doFindLastSelectedCell**

`doFindLastSelectedCell` finds the last selected cell in a list (which could, of course, also be the first selected cell if only one cell is selected).

If the call to `doFindFirstSelectedCell` reveals that no cells are currently selected, `doFindLastSelectedCell` simply returns. If, however, `doFindFirstSelectedCell` finds a selected cell, that cell is passed as the starting cell in the `LGetSelect` call.

As an example of how the rest of this function works, assume that the first selected cell is (0,1), and that cell (0,4) is the only other selected cell. `LGetSelect` examines this cell and returns true, causing the loop to execute. The first line in the while loop thus assigns (0,1) to `theCell` and the next line increments `aCell` to (0,2). `LGetSelect` starts another search using (0,2) as the starting cell. Because cells (0,2) and (0,3) are not selected, `LGetSelect` advances to cell (0,4) before it returns. Because it has found another selected cell, `LGetSelect` again returns true, so the loop executes again. `aCell` now contains (0,4), and the first line in the while loop assigns that to `theCell`. Once again, `LNextCell` increments `aCell`, this time to (0,5).

This time, however, `LGetSelect` will return false because neither cell (0,5) nor any cell below it is selected. The loop thus terminates, `theCell` containing (0,4), which is the last selected cell.



**doFindNewCellLoc**

`doFindNewCellLoc` finds the new cell to be selected in response to Arrow key presses. That cell will be either one up or one down from the cell specified in the `oldCellLoc` parameter (if the Command key was not down at the time of the Arrow key press) or the top or bottom cell (if the Command key was down).

The first line gets the number of rows in the list. (Recall that the List Manager sets the `dataBounds.bottom` coordinate to one more than the vertical coordinate of the last cell.)

If the Command key was down (`moveToTopBottom` is true) and the key pressed was the Up Arrow, the new cell to be selected is the top cell in the list. If the key pressed was the Down Arrow key, the new cell to be selected is the bottom cell in the list.

If the Command key was not down and the key pressed was the Up Arrow key, and if the first selected cell is the top cell in the list, the new cell to be selected remains as set at the second line in the function; otherwise, the new cell to be selected is set as the cell above the first selected cell. If the key pressed was the Down Arrow key, and if the last selected cell is the bottom cell in the list, the new cell to be selected remains as set at the second line in the function; otherwise, the new cell to be selected is set as the cell below the last selected cell.

**doSelectOneCell**

`doSelectOneCell` deselects all cells in the specified list and selects the specified cell.

If no cells in the list are selected, the function returns immediately. Otherwise, the first selected cell is passed as the starting cell in the call to `LGetSelect`.

The while loop will continue to execute while a selected cell exists between the starting cell specified in the `LGetSelect` call and the end of the list. Within the loop, if the current `LGetSelect` starting cell is not the cell specified for selection, that cell is deselected. When the loop exits, `LSetSelect` selects the cell specified for selection.

Note that defeating the deselection of the cell specified for selection if it is already selected (the if statement within the while loop) prevents the unsightly flickering which would occur as a result of that cell being deselected inside the loop and then selected again after the loop exits.

**doMakeCellVisible**

`doMakeCellVisible` checks whether a specified cell is within the list's display rectangle and, if not, scrolls the list until that cell is visible.

The first line gets a copy of the rectangle that encompasses the currently visible cells. (Note that this rectangle is in cell coordinates.) The if statement tests whether the specified cell is within this rectangle. If it is not, the list is scrolled as follows:

- If the specified cell is “below” the bottom of the display rectangle, the variable `dRows` is set to the difference between the cell’s `v` coordinate and the value in the bottom field of the display rectangle, plus 1. (Recall that the List Manager sets the bottom field to one greater than the `v` coordinate of the last visible cell.)
- If the specified cell is “above” the top of the display rectangle, the variable `dRows` is set to the difference between the cell’s `v` coordinate and the value in the top field of the display rectangle.

With the number of cells to scroll, and the direction to scroll, established, `LScroll` is called to effect the scroll.

### **doResetTypeSelection**

`doResetTypeSelection` resets the global variables which are central to the operation of the type selection function `doTypeSelectSearch`.

The first line resets the `tsrKeyStrokes` and `tsrLastKeyTime` fields of `gTSStruct` to `NULL` and 0 respectively. The next line sets the variable which holds the handle to the list which is the target of the current key press to `NULL`. The next line sets the variable which holds the type selection reset threshold to twice the value stored in the low memory global variable `KeyThresh`. However, if this value is greater than the value represented by the constant `kMaxKeyThresh`, the variable is made equal to `kMaxKeyThresh`.

### **doRotateCurrentList**

`doRotateCurrentList` rotates the currently active list in response to the Tab key and to mouse-downs in the non-active list.

The first line saves the handle to the currently active list. The next line retrieves the handle to the new list to be activated from the `refCon` field of the currently active list’s list structure. The third line makes the new list the currently active list.

The last two lines cause the keyboard focus frame to be erased from the previously current list, the list box frame to be drawn around the previously current list, and the keyboard focus frame to be drawn around the new current list.

### **doDrawFrameAndFocus**

`doDrawFrameAndFocus` is called by `doDrawContent`, `doActivateDeactivate`, and `doRotateCurrentList` to draw or erase the keyboard focus frame from the specified list, and to draw the list box frame in either the activated or deactivated state.

The second and third lines get the list’s rectangle from the `rView` field of the list structure and expand it to the right by the width of the scroll bar.

The machinations at the next four lines are for cosmetic purposes only. If the program is running on Mac OS 8/9, the current background color and pattern will be white, so the saved background color/pattern must be restored before the first call to `DrawThemeFocusRect`, which erases the keyboard focus frame to the background color/pattern.

Depending on the value received in the `inState` formal parameter, the list box frame is drawn in either the activated or deactivated state. If the specified list is the current list, `DrawThemeFocusRect` is called again, this time to draw the keyboard focus frame.

If the program is running on Mac OS 8/9, the last two lines reset the background color/pattern to white.

### **doExtractSelections**

`doExtractSelections` is called when the user clicks the Extract push button or double clicks an item in a list.

The first block gets the handles to the lists. The next two lines initialize the `Str255` array that will be used to hold the extracted strings.

The next block copies the data from the selected cells in the text list to the `Str255` array. The for loop is traversed once for each cell in the list. `SetPt` increments the `v` coordinate of the variable `theCell`. If the specified cell is selected (`LGetSelect`), `LGetCellDataLocation` is called to get the length of the data in the cell, and `LGetCell` is called to copy the cell's data into an element of the `Str255` array.

The next block gets the selected cell in the icon list, retrieves the related string from the specified `STR#` resource, and assigns it to the 15th element of the `Str255` array. `SetPt` sets the starting cell for the `LGetSelect` search.

The last two lines force a `kEventWindowDrawContent` event, which will cause the function `doDrawSelections` to draw the contents of the `Str255` array in the group box at the bottom of the window.

### **doDrawSelections**

`doDrawSelections` is called by `doDrawContent` and `doActivateDeactivate` to draw the contents of the `Str255` array “filled in” by the function `doExtractSelections`.

### **listDefFunction**

`listDefFunction` the custom list definition (callback) function used by the window's icon list.

The List Manager sends a list definition function four types of messages in the message parameter. Only two of these are relevant to this list definition function. `listDefFunction` calls the appropriate function to handle each message type.

### **doLDEFDraw**

`doLDEFDraw` handles the `lDrawMsg` message, which relates to a specific cell.

The first two lines save the current graphics port and set the graphics port to the port in which the list is drawn.

`EraseRect` erases the cell rectangle. The next line gets a copy of the 52-by-52 pixel cell rectangle. The next four lines adjust this rectangle to the size of a 32-by-32 pixel icon.

The `if` statement checks whether the cell's data is 4 bytes long (the size of a handle). If it is, `LGetCell` is called to get the cell's data into the variable `iconSuiteHdl` and `PlotIconSuite` is called to draw the icon within the specified rectangle. If the list is active, `kTransformNone` is passed in the transform parameter, otherwise `kTransformDisabled` is passed. This latter causes the icon to be drawn in the disabled (dimmed) state.

`GetIndString` is then called to get the string corresponding to the icon. The rectangle used to draw the icon is adjusted and passed, together with the string, in a call to `TETextBox`.

`TETextBox` draws the string, with center justification, underneath the icon.

If the `lDrawMsg` message indicated that the cell was selected, the cell highlighting function is called. The previously saved graphics port is then restored.

### **doLDEFHighlight**

`doLDEFHighlight` handles the `lHiliteMsg` message and may also be called from `doLDEFDraw`.

A copy of the value in the low memory global `HiliteMode` is acquired, `BitClr` is called to clear the highlight bit, and `HiliteMode` is set to this new value. The last line highlights the cell.

## **DialogList.c**

`doListsDialog` contains the main functions pertaining to the lists in the movable modal dialog.

### **doListsDialog**

`doListsDialog` creates a movable modal dialog using `'DLOG'`, `'dlgx'`, `'dftb'`, and `'DITL'` resources. The `'DITL'` resource contains two list controls. Each list control is supported by an `'ldes'` resource. Both `'ldes'` resources specify no rows, one column, a cell height of 14 pixels, a vertical scroll bar, and the system `LDEF`. The `'dftb'` resource specifies the small system font for the list controls.

At the first block, the window, if open, is explicitly deactivated. The dialog is then created. At the next block, the Dialog Manager is told which items are the default and Cancel items.

A custom event filter function is used. The call to `NewModalFilterProc` creates the associated universal procedure pointer.

At the next block, and for each list control, the handle to the list control is obtained, the handle to the associated list structure is obtained, the function `doAddRowsAndDataToTextList` is called to add the specified number of rows and the data to the list's cells, the cell-selection algorithm is customized to allow the selection of one cell only, and the first cell is selected.

`ShowWindow` is then called to display the dialog. The call to `SetKeyboardFocus` sets the keyboard focus to the "Date Format" list.

Within the do-while loop, `ModalDialog` retains control until an enabled item is hit. If the push buttons are hit, or if the last click in one of the list boxes was a double-click, the loop exits.

If the item hit is the "Date Format" list, `SetPt` sets the variable `theCell` to represent the first cell in the list. This is passed as a parameter in the `LGetSelect` call, which searches the list until it finds a cell that is selected. `LGetDataLocation` is called to get the length of the data in that cell and `LGetCell` is called to copy the data (a string) to a local `Str255` variable. At the next block, a reference to the static text control associated with this list is obtained and its text is set with the string obtained by `LGetCell`. `Draw1Control` is then called to draw the static text field control with this newly set text.

The last action is to check whether the last click in the list box was a double-click. If the last click was a double-click, the variable `wasDoubleClick` is set to true, causing the loop to exit.

The same general procedure is followed in the event of a hit on the "Watermark" list.

When the OK push button is hit, or one of the lists has been double-clicked, the dialog and the universal procedure pointer are disposed of.

### **eventFilter**

A custom event filter function is used to intercept `keyDown` events so as to support type selection in the "Watermark" list.

If the event is a `keyDown` event, the character code is extracted from the event structure's message field.

If the key hit was not the Up-Arrow, Down-Arrow, or tab key, the following occurs. `GetDialogItemAsControl` is called to get the reference to the "Watermark" list control, `GetControlData` is called to get the handle to the associated list, and `GetKeyboardFocus` is called to get the reference to the control with keyboard focus. If the "Watermark" list control currently has the focus, the function `doTypeSelectSearch` is called (to handle type selection) and `Draw1Control` is called on the list control to ensure that the type-selected item is highlighted. `handledEvent` is then set to true to inform `ModalDialog` that the filter function handled the event.

Apart from supporting type-selection in the "Watermark" list, this arrangement means that the only `keyDown` events received by `ModalDialog` in respect of the "Date Format" list will be Up-Arrow, Down-Arrow, and tab key events.



# Drag and Drop

## CHAPTER

# 23

## IN THIS CHAPTER

- Overview 1308
- Drag Items, Drag Item Flavors, and Handlers 1309
- The Drag Region and The Drag Image 1313
- Drag Functions—Overriding Drag Manager Default Behavior 1314
- Main Drag Manager Constants, Data Types, and Functions 1315
- Relevant TextEdit Function 1318
- Demonstration Program Drag Listing 1318
- Demonstration Program Drag Comments 1356

## Overview

### The Drag Manager

Using the Drag Manager, you can provide your application with the capability to drag objects from your application's windows, to your application's windows, and within your application's windows.

### The Three Phases of a Drag

All drag-and-drop operations comprise the following three distinct phases:

- Starting the drag.
- Tracking the drag.
- Finishing the drag.

Different applications may be involved in each of these three phases. For example, when the user drags an item from one application to another, the source application starts the drag, other applications through whose windows the user drags the item may track the drag, and the application owning the target window finishes the drag by accepting the drop (see Fig 1).

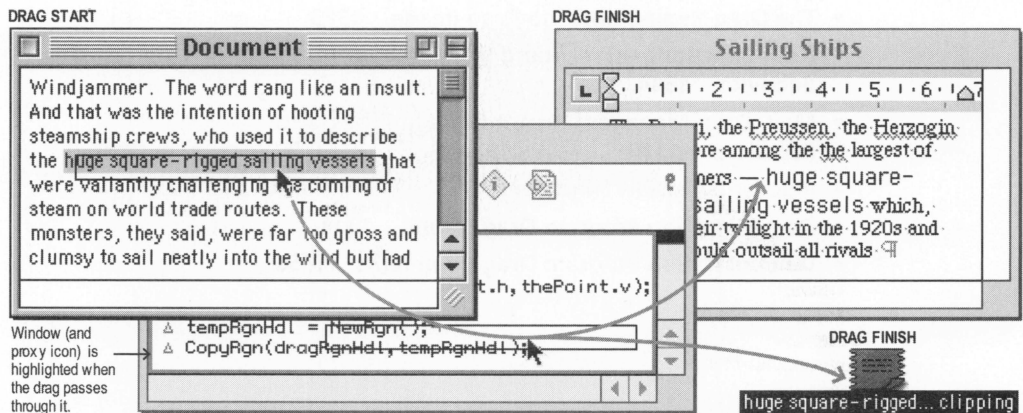


FIG 1 - STARTING, TRACKING, AND FINISHING A DRAG IN DIFFERENT APPLICATIONS

Of course, when the drag and drop is wholly within one of an application's document windows, that single application starts the drag, tracks it through the window, and accepts the drop.

### Starting the Drag

A drag is initiated when the user clicks on a selected object, keeps the mouse button down, and begins to move the mouse (see the left hand window in Fig 1). Using the function

`WaitMouseMoved`, you can determine if the mouse has moved far enough to initiate a drag. If `WaitMouseMoved` returns `true`, your application should call `NewDrag` to create a new **drag reference**. A drag reference is an opaque data type that you use to refer to a specific drag process.

Having created a drag reference, and for each item in the drag, you must then add at least one **drag item flavor** to that reference using the function `AddDragItemFlavor`. Drag item flavors represent the various data formats in which each individual item may be produced. The concept is similar to that applying to Scrap flavors as described in Chapter 20.

With the drag item flavor (or flavors) added, your application can then initiate tracking by calling the function `TrackDrag`.

## Tracking the Drag—Drag Tracking Handlers

The Drag Manager tracks the drag through each window the cursor moves over as the user drags the selection across the screen. During this process, the user is presented with the following feedback:

- Destination highlighting will occur when the cursor has left the source location. (See the middle window in Fig 1, whose owner application supports drag and drop and can accept the drop.)
- If a container under the cursor (such as a folder in the Finder) can accept the drop, that container will be highlighted.

As the cursor moves through the middle window in Fig 1, for example, the Drag Manager calls a function, called a **drag tracking handler**, defined by that window's owner application. Drag tracking handlers inspect the description of the item, or items, being dragged and highlight the window if this inspection reveals that the window can accept the drop. The application's drag tracking handler uses the functions `ShowDragHilite` and `HideDragHilite` to create and remove the highlighting. (The acceptable drop region, and thus the region highlighted, does not necessarily have to be the whole of the window's content region.)

## Finishing the Drag—Drag Receive Handlers

When the user releases the mouse button in the right hand window in Fig 1, for example, the Drag Manager calls a function, called a **drag receive handler**, defined by that window's owner application. Drag receive handlers accept the drop and insert the selection at its final destination.

# Drag Items, Drag Item Flavors, and Handlers

## Drag Items and Item Reference Numbers

A **drag item** is a single distinct object, which could be, for example, a selection from a painting in a painting program, a selection of objects in a drawing program, or a continuous range



of text in a text editing program. A discontinuous selection of text (resulting from using the Command key in some programs) would result in multiple drag items.

A new drag item is created if the **item reference number** passed in the `theItemRef` parameter of a call to `AddDragItemFlavor` is different from any other item reference number.

#### NOTE

In many cases it is easiest to use index numbers as item reference numbers (for example, 1, 2, 3...). Item reference numbers are only used as unique “key” numbers for each item. Item reference numbers do not need to be given in order, nor must they be sequential. Depending on your application, it might be easier to use your own internal memory addresses as item reference numbers (as long as each item being dragged has a unique item reference number).

## Drag Item Flavors

Any item that can be dragged can generally be represented using several different flavors (that is, data formats). At the start of a drag, your application must inform the Drag Manager, using the function `AddDragItemFlavor`, of the flavors that you can provide to the receiver of the drag. For example, if the drag item is a selection of text, you might elect to provide the data in both the standard 'TEXT' format and in the Rich Text Format (RTF). Alternatively, instead of supplying the data in RTF, you might supplement the 'TEXT' data with 'styl' data. You might also provide the data in your application's own internal data format to cater for a drag and drop to one of your application's documents, including the source document.

Your application adds additional flavors to an item by passing the same item reference number in the `AddDragItemFlavor` call as was used in the `AddDragItemFlavor` call which created the item and added the first flavor.

Different destinations may prefer different data formats, and there is no certainty as to whether a drag will contain the preferred, or an acceptable, flavor. Thus, as previously stated, the destination application needs to inspect the description of the items being dragged to determine whether an acceptable flavor is available and only highlight the relevant window if it can accept a drop. The function `GetFlavorFlags` is used to determine whether the drag contains a specific flavor type.

## Flavor Flags

The following flavor flags, which are used by the Drag Manager and its clients to provide additional information about a specific drag item flavor, may be passed in the `theFlags` parameter of the function `AddDragItemFlavor` and retrieved by the function `GetFlavorFlags`:

Flag	Description
flavorSenderOnly	Set by the sender if the flavor should only be available to the sender.
flavorSenderTranslated	Set if the flavor data is translated by the sender. Useful if the receiver needs to ascertain whether the sender is performing its own translation to generate this data type.
flavorNotSaved	Set by the sender if the flavor data should not be stored by the receiver. Useful for marking flavor data that will become stale after the drag is completed.
flavorSystemTranslated	Set if the flavor data is translated by the Translation Manager. If this flavor is requested, the Drag Manager will acquire the required data type from the sender and then use the Translation Manager to provide the data requested by the receiver.

NOTE

Note that the Finder does not save flavor types marked with the `flavorSenderTranslated`, `flavorNotSaved`, and `flavorSystemTranslated` flags into clippings files.

Drag Handlers

Drag tracking handlers and drag receive handlers are callback functions that your application registers with the Drag Manager using the functions `InstallTrackingHandler` and `InstallReceiveHandler`. The window reference of the window on which the handlers are to be installed is passed in the `theWindow` parameter of the two handler installer functions. You can install more than one tracking handler and more than one receive handler on the same window, in which case the Drag Manager calls each of the handlers in the order they were installed.

If you pass `NULL` in the `theWindow` parameter of the handler installer functions, the Drag Manager will register the handler in a special area that is used when the drag occurs in any window of your application. Handlers installed in this special area are called **default handlers**.

Drag Tracking Handlers

As the user moves the mouse through your application’s windows during the drag, the Drag Manager sends status messages to your tracking handler. These messages are as follows:

Message	Description
Enter handler	Received when the focus of the drag enters a window handled by your tracking handler from a window not handled by your tracking handler.
Enter window	Received when the focus of a drag enters any window handled by your tracking handler.
In window	Received as the user drags within a window handled by your tracking handler.
Leave window	Received when the focus of a drag leaves a window that is handled by your tracking handler.
Leave handler	Received when the focus of a drag enters a window that is not handled by your tracking handler.

Fig 2 illustrates the receipt of tracking messages involving multiple applications and windows.

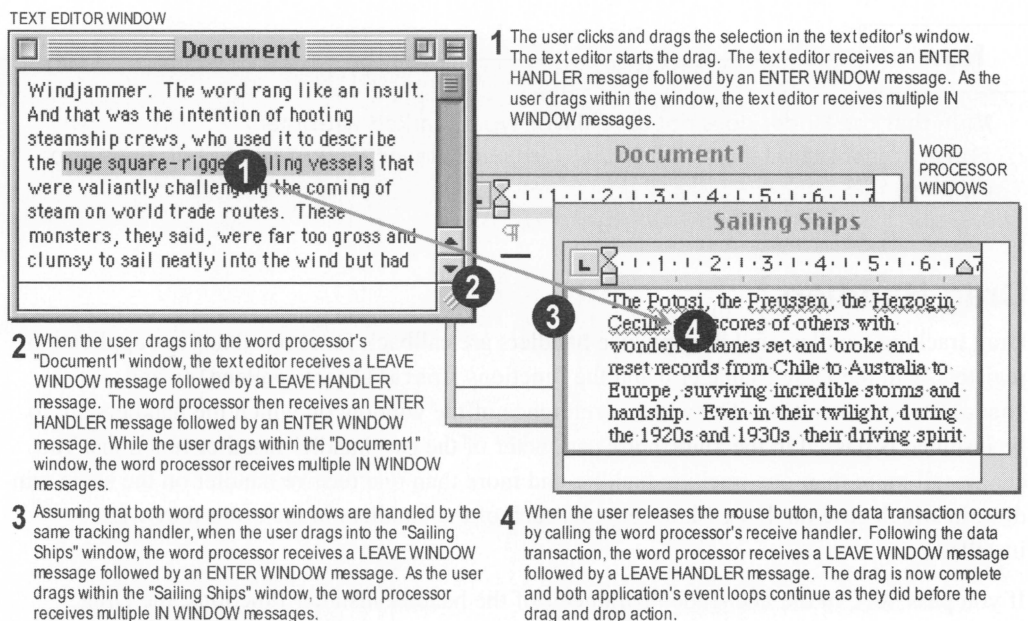


FIG 2 - DRAG TRACKING THROUGH MULTIPLE APPLICATIONS AND WINDOWS

## Drag Receive Handlers

When the user drops an item, or a collection of items, in one of your application's windows, the Drag Manager calls any receive handlers installed on the destination window. Your receive handler can then request the drag item flavor, or flavors, that you wish to accept and insert the data at its final destination.

When the drop occurs within the window in which the drag originated, and the user did not press the Option key either before the mouse button went down or before it was released, receive handlers must delete the original selection before inserting the dropped data. If the option button was not pressed, receive handlers must not delete the selection.

## The Drag Region and The Drag Image

### Creating the Drag Region

Recall that your application initiates tracking by calling the function `TrackDrag`. This function takes a region, specifically, the **drag region**, in its `theRgn` parameter. This is the region, drawn by the Drag Manager in the dithered gray pattern (Mac OS 8/9) or gray color (Mac OS X), that moves with the mouse during the drag (see Fig 1).

As an example, to create a drag region when a single item is selected, your application should

- Copy the drag item's region to a temporary region and inset the temporary region by 1 pixel.
- Use `DiffRgn` to subtract the temporary region from a copy of the item's region.

The resulting copy of the item's region has the same outline as the item's original region but is only one pixel thick (see Fig 3).

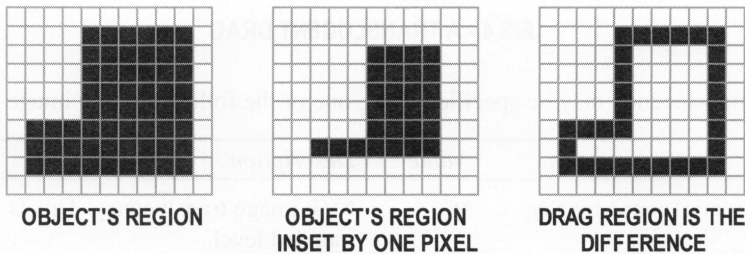


FIG 3 - CREATING THE DRAG REGION

### Setting the Drag Image—Translucent Drags

The drag region may also be visually represented to the user by a translucent image of the original selection (see Fig 4).

To support translucent dragging of a text selection on Mac OS 8/9, you should

- Create an offscreen graphics world the size of the bounding rectangle of the highlight region. The offscreen graphics world should be eight bits deep.
- Copy the area of the window enclosed by the highlight region's bounding rectangle to the offscreen graphics world.

- Create a region for a mask that is exactly the same shape as the highlight region. (Note that if you do not supply a mask, the entire rectangular area of the offscreen pixel map, including white space, will be dragged.)
- Call `SetDragImage` to associate the image with the drag reference, passing in the handle to the offscreen pixel map, the handle to the mask region, and a constant specifying the required level of translucency. `SetDragImage` installs a custom drawing function (see below) to perform the translucent drawing.

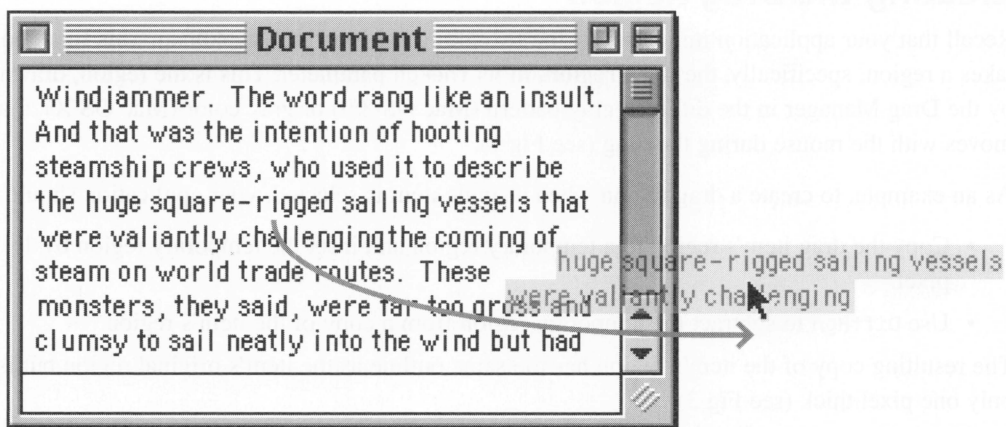


FIG 4 - A TRANSLUCENT DRAG

The level of translucency may be specified using one of the following drag image flags:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kDragStandardTranslucency</code>	<code>0L</code>	65% image translucency. This is the recommended level.
<code>kDragDarkTranslucency</code>	<code>1L</code>	50% image translucency.
<code>kDragDarkerTranslucency</code>	<code>2L</code>	25% image translucency.
<code>kDragOpaqueTranslucency</code>	<code>3L</code>	0% image translucency (opaque).

## Drag Functions—Overriding Drag Manager Default Behavior

If you wish to override the Drag Manager's default behavior, you can supply it with several different kinds of drag function. Only the sender can specify drag functions.



## Drawing Function

When a drawing function is installed, the Drag Manager sends that function a sequence of messages that allow the application to assume responsibility for drawing the drag region (or similar feedback) on the screen. If translucent dragging is used, you must not install a custom drawing function.

## Send Data Function

If you install a send data function, the Drag Manager calls that function when the receiver application requests a drag item flavor that the Drag Manager does not currently have the data cached for.

Ordinarily, the Drag Manager caches the flavor data for all flavors that were added to the drag with the `AddDragItemFlavor` function. If a receiver calls `GetFlavorData` to get a flavor's data, the Drag Manager simply returns the cached data to the receiver.

However, if your application passes `NULL` as the pointer to the flavor data in the `AddDragItemFlavor` call, the Drag Manager does not cache the data. In effect, your application has made a “promise” to later supply the data in the event that a receiver requests it. Thus, if a receiver calls `GetFlavorData` for that particular flavor, the Drag Manager will call your send data function to get the data from the sender. Your send data function should then create that flavor's data and call `SetDragItemFlavorData` to send the data to the Drag Manager.

This mechanism of “promising” data that may, in the event, not be called for by a receiver is useful where the sender must perform expensive computations to produce the data or if the resulting data requires a large amount of memory to store.

## Drag Input Function

If you install a **drag input function**, the Drag Manager calls that function when sampling the mouse position and keyboard state to allow the application to override the current state of the input devices. The Drag Manager passes the current mouse location, mouse button state, and keyboard modifier status to your drag input function, which can then modify those parameters.

## Main Drag Manager Constants, Data Types, and Functions

### Constants

#### Flavor Flags

<code>flavorSenderOnly</code>	<code>= (1 &lt;&lt; 0)</code>
<code>flavorSenderTranslated</code>	<code>= (1 &lt;&lt; 1)</code>
<code>flavorNotSaved</code>	<code>= (1 &lt;&lt; 2)</code>
<code>flavorSystemTranslated</code>	<code>= (1 &lt;&lt; 8)</code>

## Drag Attributes

```
kDragHasLeftSenderWindow    = (1L << 0)
kDragInsideSenderApplication = (1L)
kDragInsideSenderWindow     = (1L << 2)
```

## Drag Tracking Handler Messages

```
kDragTrackingEnterHandler    = 1
kDragTrackingEnterWindow     = 2
kDragTrackingInWindow        = 3
kDragTrackingLeaveWindow      = 4
kDragTrackingLeaveHandler     = 5
```

## Drag Image Flags

```
kDragStandardTranslucency    = 0L
kDragDarkTranslucency        = 1L
kDragDarkerTranslucency      = 2L
kDragOpaqueTranslucency      = 3L
```

## Drag Drawing Handler Messages

```
kDragRegionBegin            = 1
kDragRegionDraw             = 2
kDragRegionHide             = 3
kDragRegionIdle             = 4
kDragRegionEnd              = 5
```

## Data Types

```
typedef struct OpaqueDragRef *DragRef;
typedef UInt32 DragItemRef;
typedef OSType FlavorType;
typedef UInt32 DragAttributes;
typedef UInt32 FlavorFlags;
typedef SInt16 DragTrackingMessage;
typedef SInt16 DragRegionMessage;
typedef UInt32 DragImageFlags;
```

## Functions

### Installing and Removing Drag Handlers

```
OSErr InstallTrackingHandler(DragTrackingHandlerUPP trackingHandler, WindowRef theWindow,
                             void *handlerRefCon);
OSErr InstallReceiveHandler(DragReceiveHandlerUPP receiveHandler, WindowRef theWindow,
                             void *handlerRefCon);
OSErr RemoveTrackingHandler(DragTrackingHandlerUPP trackingHandler, WindowRef theWindow);
OSErr RemoveReceiveHandler(DragReceiveHandlerUPP receiveHandler, WindowRef theWindow);
```

### Creating and Disposing of Drag References

```
OSErr NewDrag(DragRef *theDrag);
OSErr DisposeDrag(DragRef theDrag);
```

## Adding Drag Item Flavors

```
OSErr AddDragItemFlavor(DragRef theDrag, DragItemRef theItemRef, FlavorType theType,
    const void *dataPtr, Size dataSize, FlavorFlags theFlags);
OSErr SetDragItemFlavorData(DragRef theDrag, DragItemRef theItemRef, FlavorType theType,
    const void *dataPtr, Sized ataSize, UInt32 dataOffset);
```

## Performing a Drag

```
OSErr TrackDrag(DragRef theDrag, const EventRecord *theEvent, RgnHandle theRegion);
```

## Getting Drag Item Information

```
OSErr CountDragItems(DragRef theDrag, UInt16 *numItems);
OSErr GetDragItemReferenceNumber(DragRef theDrag, UInt16 index, DragItemRef *theItemRef);
OSErr CountDragItemFlavors(DragRef theDrag, DragItemRef theItemRef, UInt16 *numFlavors);
OSErr GetFlavorType(DragRef theDrag, DragItemRef theItemRef, UInt16 index, FlavorType *theType);
OSErr GetFlavorFlags(DragRef theDrag, DragItemRef theItemRef, FlavorType theType,
    FlavorFlags *theFlags);
OSErr GetFlavorDataSize(DragRef theDrag, DragItemRef theItemRef, FlavorType theType,
    Size *dataSize);
OSErr GetFlavorData(DragRef theDrag, DragItemRef theItemRef, FlavorType theType, void * dataPtr,
    Size *dataSize, UInt32 dataOffset);
```

## Getting and Setting Drag Status Information

```
OSErr GetDragAttributes(DragRef theDrag, DragAttributes *flags);
OSErr GetDragMouse(DragRef theDrag, Point *mouse, Point *globalPinnedMouse);
OSErr SetDragMouse(DragRef theDrag, Point globalPinnedMouse);
OSErr GetDragOrigin(DragRef theDrag, Point *globalInitialMouse);
OSErr GetDragModifiers(DragRef theDrag, SInt16 *modifiers, SInt16 *mouseDownModifiers,
    SInt16 *mouseUpModifiers);
```

## Window Highlighting Utilities

```
OSErr ShowDragHilite(DragRef theDrag, RgnHandle hiliteFrame, Boolean inside);
OSErr HideDragHilite(DragRef theDrag);
OSErr UpdateDragHilite(DragRef theDrag, RgnHandle updateRgn);
```

## Drag Manager Utilities

```
Boolean WaitMouseMoved(Point initialMouse);
```

## Setting Drag Functions

```
OSErr SetDragSendProc(DragRef theDrag, DragSendDataUPP sendProc, void *dragSendRefCon);
OSErr SetDragInputProc(DragRef theDrag, DragInputUPP inputProc, void *dragInputRefCon);
OSErr SetDragDrawingProc(DragRef theDrag, DragDrawingUPP drawingProc, void *dragDrawingRefCon);
```

## Setting the Drag Image—Translucent Dragging

```
OSErr SetDragImage (DragRef theDrag, PixMapHandle imagePixMap, RgnHandle imageRgn,
    Point imageOffsetPt, DragImageFlags theImageFlags);
```

## Creating and Disposing of Universal Procedure Pointers

```
DragTrackingHandlerUPP NewDragTrackingHandlerUPP(DragTrackingHandlerProcPtr userRoutine);
DragReceiveHandlerUPP NewDragReceiveHandlerUPP(DragReceiveHandlerProcPtr userRoutine);
DragSendDataUPP NewDragSendDataUPP(DragSendDataProcPtr userRoutine);
DragInputUPP NewDragInputUPP(DragInputProcPtr userRoutine);
```



```

DragDrawingUPP          NewDragDrawingUPP(DragDrawingProcPtr userRoutine);
void    DisposeDragTrackingHandlerUPP(DragTrackingHandlerUPP userUPP);
void    DisposeDragReceiveHandlerUPP(DragReceiveHandlerUPP userUPP);
void    DisposeDragSendDataUPP(DragSendDataUPP userUPP);
void    DisposeDragInputUPP(DragInputUPP userUPP);
void    DisposeDragDrawingUPP(DragDrawingUPP userUPP);

```

### Application Defined (Callback) Functions

```

OSErr    myDragTrackingHandler(DragTrackingMessage message, WindowRef theWindow,
                                void *handlerRefCon, DragRef theDrag);
OSErr    myDragReceiveHandler(WindowRef theWindow, void *handlerRefCon, DragRef theDrag);
OSErr    muDragSendDataFunction(FlavorType theType, void *dragSendRefCon, DragItemRef theItemRef,
                                DragRef theDrag);
OSErr    myDragInputFunction(Point *mouse, SInt16 *modifiers, void *dragInputRefCon,
                                DragRef theDrag);
OSErr    myDragDrawingFunction(DragRegionMessage message, RgnHandle showRegion,
                                Point showOrigin, RgnHandle hideRegion, Point hideOrigin, void *dragDrawingRefCon,
                                DragRef theDrag);

```

## Relevant TextEdit Function

```

OSErr    TEGetHiliteRgn(RgnHandle region, TEHandle hTE);

```

## Demonstration Program Drag Listing

```

// *****
// Drag.h                                                    CARBON EVENT MODEL
// *****
//
// This program demonstrates drag and drop utilising the Drag Manager. Support for Undo and
// Redo of drag and drop within the source window is included.
//
// The bulk of the code in the source code file Drag.c is identical to the code in the file
// Text1.c in the demonstration program MonoTextEdit (Chapter 21).
//
// The program utilises the following resources:
//
// · A 'plst' resource.
//
// · An 'MBAR' resource, and 'MENU' resources for Apple, File, and Edit menus.
//
// · A 'WIND' resource (purgeable) (initially visible).
//
// · 'CNTL' resources (purgeable) for the vertical scroll bars in the text editor window and
//   Help dialog, and for the pop-up menu in the Help Dialog.
//
// · A 'STR#' resource (purgeable) containing error text strings.
//
// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//

```

```
// *****

// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenuBar          128
#define mAppleApplication 128
#define iAbout            1
#define mFile             129
#define iNew              1
#define iOpen             2
#define iClose            4
#define iSaveAs           6
#define iQuit             12
#define mEdit             130
#define iUndo             1
#define iCut              3
#define iCopy             4
#define iPaste            5
#define iClear            6
#define iSelectAll        7
#define rWindow           128
#define rVScrollbar       128
#define rErrorStrings     128
#define eMenuBar         1
#define eWindow           2
#define eDocStructure     3
#define eTextEdit         4
#define eExceedChara      5
#define eNoSpaceCut       6
#define eNoSpacePaste     7
#define eDragHandler      8
#define eDrag             9
#define eDragUndo        10
#define kMaxTELength      32767
#define kTab              0x09
#define kBackSpace        0x08
#define kForwardDelete    0x7F
#define kReturn           0x0D
#define kEscape           0x1B
#define kReturn           0x0D
#define kFileCreator      'KJbb'
#define topLeft(r)        (((Point *) &(r))[0])
#define botRight(r)       (((Point *) &(r))[1])

// ..... typedefs

typedef struct
{
    TEHandle    textEditStrucHdl;
    ControlRef  vScrollbarRef;

```

```

WindowRef  windowRef;
Boolean    windowTouched;
Handle     preDragText;
SInt16     preDragSelStart;
SInt16     preDragSelEnd;
SInt16     postDropSelStart;
SInt16     postDropSelEnd;
} docStructure, *docStructurePointer;

```

```
// ..... function prototypes
```

```

void        main                (void);
void        doPreliminaries     (void);
OSStatus    appEventHandler     (EventHandlerCallRef,EventRef,void *);
OSStatus    windowEventHandler  (EventHandlerCallRef,EventRef,void *);
void        doIdle              (void);
void        doKeyEvent          (SInt8);
void        scrollActionFunction (ControlRef,SInt16);
void        doInContent         (Point,EventRecord *,Boolean);
void        doDrawContent       (WindowRef);
void        doActivateDeactivate (WindowRef,Boolean);
void        doOSEvent           (EventRecord *);
WindowRef    doNewDocWindow     (void);
EventHandlerUPP doGetHandlerUPP (void);
Boolean      customClickLoop    (void);
void        doSetScrollbarValue (ControlRef,SInt16 *);
void        doAdjustMenus       (void);
void        doMenuChoice        (MenuItemID,MenuItemIndex);
void        doFileMenu          (MenuItemIndex);
void        doEditMenu          (MenuItemIndex);
SInt16       doGetSelectLength  (TEHandle);
void        doAdjustScrollbar   (WindowRef);
void        doAdjustCursor      (WindowRef);
void        doCloseWindow       (WindowRef);
void        doSaveAsFile        (TEHandle);
void        doOpenCommand       (void);
void        doOpenFile          (FSSpec);
void        doErrorAlert        (SInt16);
void        navEventFunction     (NavEventCallbackMessage,NavCBRecPtr,
                                NavCallBackUserData);

OSErr       doStartDrag         (EventRecord *,RgnHandle,TEHandle);
OSErr       dragTrackingHandler  (DragTrackingMessage,WindowRef,void *,DragRef);
SInt16      doGetOffset         (Point,TEHandle);
SInt16      doIsOffsetAtLineStart (SInt16,TEHandle);
void        doDrawCaret         (SInt16,TEHandle);
SInt16      doGetLine           (SInt16,TEHandle);

OSErr       dragReceiveHandler   (WindowRef,void *,DragRef);
Boolean     doIsWhiteSpaceAtOffset (SInt16,TEHandle);
Boolean     doIsWhiteSpace      (char);
char        doGetCharAtOffset   (SInt16,TEHandle);

```

```

SInt16      doInsertTextAtOffset    (SInt16,Ptr,SInt32,TEHandle);
Boolean      doSavePreInsertionText (docStructurePointer);
void         doUndoRedoDrag         (WindowRef);

// *****
// Drag.c
// *****

// ..... includes

#include "Drag.h"

// ..... global variables

ControlActionUPP      gScrollActionFunctionUPP;
TEClickLoopUPP        gCustomClickLoopUPP;
DragTrackingHandlerUPP gDragTrackingHandlerUPP;
DragReceiveHandlerUPP gDragReceiveHandlerUPP;
Boolean               gRunningOnX           = false;
SInt16                gNumberOfWindows      = 0;
SInt16                gOldControlValue;
Boolean               gEnableDragUndoRedoItem = false;
Boolean               gUndoFlag;

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;
    MenuRef        menuRef;
    EventTypeSpec applicationEvents[] = { { kEventClassApplication, kEventAppActivated },
                                           { kEventClassApplication, kEventAppDeactivated },
                                           { kEventClassCommand,      kEventProcessCommand },
                                           { kEventClassMenu,          kEventMenuEnableItems },
                                           { kEventClassMouse,         kEventMouseMoved } };

    // ..... do preliminaries

    doPreliminaries();

    // ..... create universal procedure pointers

    gScrollActionFunctionUPP = NewControlActionUPP((ControlActionProcPtr) scrollActionFunction);
    gCustomClickLoopUPP      = NewTEClickLoopUPP((TEClickLoopProcPtr) customClickLoop);

    gDragTrackingHandlerUPP = NewDragTrackingHandlerUPP((DragTrackingHandlerProcPtr)
                                                         dragTrackingHandler);
    gDragReceiveHandlerUPP  = NewDragReceiveHandlerUPP((DragReceiveHandlerProcPtr)
                                                         dragReceiveHandler);

```

```

// ..... set up menu bar and menus

menubarHdl = GetNewMBar(rMenuBar);
if(menubarHdl == NULL)
    doErrorAlert(eMenuBar);
SetMenuBar(menubarHdl);
DrawMenuBar();

Gestalt(gestaltMenuMgrAttr,&response);
if(response & gestaltMenuMgrAquaLayoutMask)
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
    {
        DeleteMenuItem(menuRef,iQuit);
        DeleteMenuItem(menuRef,iQuit - 1);
    }

    gRunningOnX = true;
}
else
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
        SetMenuItemCommandID(menuRef,iQuit,kHICCommandQuit);
}

// ..... install application event handler

InstallApplicationEventHandler(NewEventHandlerUPP((EventHandlerProcPtr) appEventHandler),
                             GetEventTypeCount(applicationEvents),applicationEvents,
                             0,NULL);

// ..... install a timer

InstallEventLoopTimer(GetCurrentEventLoop(),0,TicksToEventTime(GetCaretTime()),
                      NewEventLoopTimerUPP((EventLoopTimerProcPtr) doIdle),NULL,
                      NULL);

// ..... open window

doNewDocWindow();

// ..... run application event loop

RunApplicationEventLoop();
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(192);
    InitCursor();
}

```

```
// ***** appEventHandler
```

```
OSStatus appEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                        void * userData)
```

```
{
    OSStatus      result = eventNotHandledErr;
    UInt32        eventClass;
    UInt32        eventKind;
    HICommand     hiCommand;
    MenuID        menuID;
    MenuItemIndex  menuItem;
    WindowClass   windowClass;

    eventClass = GetEventClass(eventRef);
    eventKind  = GetEventKind(eventRef);

    switch(eventClass)
    {
    case kEventClassApplication:
        if(eventKind == kEventAppActivated)
            SetThemeCursor(kThemeArrowCursor);
        break;

    case kEventClassCommand:
        if(eventKind == kEventProcessCommand)
        {
            GetEventParameter(eventRef, kEventParamDirectObject, typeHICommand, NULL,
                             sizeof(HICommand), NULL, &hiCommand);
            menuID = GetMenuID(hiCommand.menu.menuRef);
            menuItem = hiCommand.menu.menuItemIndex;
            if((hiCommand.commandID != kHICommandQuit) &&
               (menuID >= mAppleApplication && menuID <= mEdit))
            {
                doMenuChoice(menuID, menuItem);
                result = noErr;
            }
        }
        break;

    case kEventClassMenu:
        if(eventKind == kEventMenuEnableItems)
        {
            GetWindowClass(FrontWindow(), &windowClass);
            if(windowClass == kDocumentWindowClass)
                doAdjustMenus();
            result = noErr;
        }
        break;

    case kEventClassMouse:
        if(eventKind == kEventMouseMoved)
        {
            GetWindowClass(FrontWindow(), &windowClass);
            if(windowClass == kDocumentWindowClass)
                doAdjustCursor(FrontWindow());
            result = noErr;
        }
    }
}
```

```

        break;
    }

    return result;
}

// ***** windowEventHandler

OSStatus windowEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                           void* userData)
{
    OSStatus      result = eventNotHandledErr;
    UInt32        eventClass;
    UInt32        eventKind;
    WindowRef     windowRef;
    UInt32        modifiers;
    Point         mouseLocation;
    Boolean        shiftKeyDown = false;
    EventRecord    eventRecord;
    ControlRef     controlRef;
    ControlPartCode controlPartCode;
    SInt8         charCode;

    eventClass = GetEventClass(eventRef);
    eventKind  = GetEventKind(eventRef);

    switch(eventClass)
    {
    case kEventClassWindow: // event class window
        GetEventParameter(eventRef, kEventParamDirectObject, typeWindowRef, NULL, sizeof(windowRef),
                           NULL, &windowRef);
        switch(eventKind)
        {
        case kEventWindowDrawContent:
            doDrawContent(windowRef);
            result = noErr;
            break;

        case kEventWindowActivated:
            doActivateDeactivate(windowRef, true);
            result = noErr;
            break;

        case kEventWindowDeactivated:
            doActivateDeactivate(windowRef, false);
            result = noErr;
            break;

        case kEventWindowClickContentRgn:
            SetPortWindowPort(FrontWindow());
            GetMouse(&mouseLocation);
            GetEventParameter(eventRef, kEventParamKeyModifiers, typeUInt32, NULL,
                               sizeof(modifiers), NULL, &modifiers);

```

```

        if(modifiers & shiftKey)
            shiftKeyDown = true;
        ConvertEventRefToEventRecord(eventRef,&eventRecord);
        doInContent(mouseLocation,&eventRecord,shiftKeyDown);
        result = noErr;
        break;

    case kEventWindowClose:
        doCloseWindow(windowRef);
        result = noErr;
        break;
}
break;

case kEventClassMouse:
    switch(eventKind)
    {
        case kEventMouseDown:
            GetEventParameter(eventRef,kEventParamMouseLocation,typeQDPoint,NULL,
                             sizeof(mouseLocation),NULL,&mouseLocation);
            SetPortWindowPort(FrontWindow());
            GlobalToLocal(&mouseLocation);
            controlRef = FindControlUnderMouse(mouseLocation,FrontWindow(),&controlPartCode);
            if(controlRef)
            {
                gOldControlValue = GetControlValue(controlRef);
                TrackControl(controlRef,mouseLocation,gScrollActionFunctionUPP);
                result = noErr;
            }
            break;
    }
    break;

case kEventClassKeyboard:
    switch(eventKind)
    {
        case kEventRawKeyDown:
        case kEventRawKeyRepeat:
            GetEventParameter(eventRef,kEventParamKeyMacCharCodes,typeChar,NULL,
                             sizeof(charCode),NULL,&charCode);
            GetEventParameter(eventRef,kEventParamKeyModifiers,typeUInt32,NULL,
                             sizeof(modifiers),NULL,&modifiers);
            if((modifiers & cmdKey) == 0)
                doKeyEvent(charCode);
            result = noErr;
            break;
    }
    break;
}

return result;
}

```



```
// ***** doIdle

void doIdle(void)
{
    WindowRef          windowRef;
    docStructurePointer docStrucPtr;

    windowRef = FrontWindow();
    if(GetWindowKind(windowRef) == kApplicationWindowKind)
    {
        docStrucPtr = (docStructurePointer) (GetWRefCon(windowRef));
        if(docStrucPtr != NULL)
            TEIdle(docStrucPtr->textEditStrucHdl);
    }
}

// ***** doKeyEvent

void doKeyEvent(SInt8 charCode)
{
    WindowRef          windowRef;
    docStructurePointer docStrucPtr;
    TEHandle            textEditStrucHdl;
    SInt16              selectionLength;

    if(charCode <= kEscape && charCode != kBackSpace && charCode != kReturn)
        return;

    windowRef = FrontWindow();
    docStrucPtr = (docStructurePointer) (GetWRefCon(windowRef));
    textEditStrucHdl = docStrucPtr->textEditStrucHdl;

    gEnableDragUndoRedoItem = false;

    if(charCode == kTab)
    {
        // Do tab key handling here if required.
    }
    else if(charCode == kForwardDelete)
    {
        selectionLength = doGetSelectLength(textEditStrucHdl);
        if(selectionLength == 0)
            (*textEditStrucHdl)->selEnd += 1;
        TDelete(textEditStrucHdl);
        doAdjustScrollbar(windowRef);
    }
    else
    {
        selectionLength = doGetSelectLength(textEditStrucHdl);
        if(((textEditStrucHdl)->teLength - selectionLength + 1) < kMaxTELength)
        {
            TEKey(charCode, textEditStrucHdl);
            doAdjustScrollbar(windowRef);
        }
    }
}
```

```

    else
        doErrorAlert(eExceedChara);
}
}

// ***** scrollActionFunction

void scrollActionFunction(ControlRef controlRef, SInt16 partCode)
{
    WindowRef          windowRef;
    docStructurePointer docStrucPtr;
    TEHandle            textEditStrucHdl;
    SInt16              linesToScroll;
    SInt16              controlValue, controlMax;

    windowRef = GetControlOwner(controlRef);
    docStrucPtr = (docStructurePointer) (GetWRefCon(windowRef));
    textEditStrucHdl = docStrucPtr->textEditStrucHdl;

    controlValue = GetControlValue(controlRef);
    controlMax = GetControlMaximum(controlRef);

    if(partCode)
    {
        if(partCode != kControlIndicatorPart)
        {
            switch(partCode)
            {
                case kControlUpButtonPart:
                case kControlDownButtonPart:
                    linesToScroll = 1;
                    break;

                case kControlPageUpPart:
                case kControlPageDownPart:
                    linesToScroll = (((*textEditStrucHdl)->viewRect.bottom -
                                        (*textEditStrucHdl)->viewRect.top) /
                                        (*textEditStrucHdl)->lineHeight) - 1;

                    break;
            }
        }

        if((partCode == kControlDownButtonPart) || (partCode == kControlPageDownPart))
            linesToScroll = -linesToScroll;

        linesToScroll = controlValue - linesToScroll;
        if(linesToScroll < 0)
            linesToScroll = 0;
        else if(linesToScroll > controlMax)
            linesToScroll = controlMax;

        SetControlValue(controlRef, linesToScroll);

        linesToScroll = controlValue - linesToScroll;
    }
}

```

```

    else
    {
        linesToScroll = gOldControlValue - controlValue;
        gOldControlValue = controlValue;
    }

    if(linesToScroll != 0)
        TEScroll(0,linesToScroll * (*textEditStrucHdl)->lineHeight,textEditStrucHdl);
}

// ***** doInContent

void doInContent(Point mouseLocation,EventRecord * eventStrucPtr,Boolean shiftKeyDown)
{
    WindowRef          windowRef;
    docStructurePointer docStrucPtr;
    TEHandle            textEditStrucHdl;
    RgnHandle           hiliteRgn;
    OSErr               osError;

    windowRef = FrontWindow();
    docStrucPtr = (docStructurePointer) GetWRefCon(windowRef);
    textEditStrucHdl = docStrucPtr->textEditStrucHdl;

    if(PtInRect(mouseLocation,&(*textEditStrucHdl)->viewRect))
    {
        hiliteRgn = NewRgn();

        TEGetHiliteRgn(hiliteRgn,textEditStrucHdl);

        if(!EmptyRgn(hiliteRgn) && PtInRgn(mouseLocation,hiliteRgn))
        {
            if(WaitMouseMoved(mouseLocation))
            {
                osError = doStartDrag(eventStrucPtr,hiliteRgn,textEditStrucHdl);
                if(osError != noErr)
                    doErrorAlert(eDrag);
            }
        }
        else
        {
            TEClick(mouseLocation,shiftKeyDown,textEditStrucHdl);
            gEnableDragUndoRedoItem = false;
        }

        DisposeRgn(hiliteRgn);
    }
}

```

```
// ***** doDrawContent

void doDrawContent(WindowRef windowRef)
{
    docStructurePointer docStrucPtr;
    TEHandle             textEditStrucHdl;
    GrafPtr             oldPort;
    RgnHandle            visibleRegionHdl = NewRgn();
    Rect                portRect;

    docStrucPtr = (docStructurePointer) (GetWRefCon(windowRef));
    textEditStrucHdl = docStrucPtr->textEditStrucHdl;

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    GetPortVisibleRegion(GetWindowPort(windowRef), visibleRegionHdl);
    EraseRgn(visibleRegionHdl);

    UpdateControls(windowRef, visibleRegionHdl);

    GetWindowPortBounds(windowRef, &portRect);
    TEUpdate(&(*textEditStrucHdl)->viewRect, textEditStrucHdl);

    DisposeRgn(visibleRegionHdl);
    SetPort(oldPort);
}

// ***** doActivateDocWindow

void doActivateDeactivate(WindowRef windowRef, Boolean becomingActive)
{
    docStructurePointer docStrucPtr;
    TEHandle             textEditStrucHdl;

    docStrucPtr = (docStructurePointer) (GetWRefCon(windowRef));
    textEditStrucHdl = docStrucPtr->textEditStrucHdl;

    if(becomingActive)
    {
        SetPortWindowPort(windowRef);

        (*textEditStrucHdl)->viewRect.bottom = (((*textEditStrucHdl)->viewRect.bottom -
            (*textEditStrucHdl)->viewRect.top) /
            (*textEditStrucHdl)->lineHeight) *
            (*textEditStrucHdl)->lineHeight) +
            (*textEditStrucHdl)->viewRect.top;
        (*textEditStrucHdl)->destRect.bottom = (*textEditStrucHdl)->viewRect.bottom;

        TEActivate(textEditStrucHdl);
        ActivateControl(docStrucPtr->vScrollbarRef);
        doAdjustScrollbar(windowRef);
        doAdjustCursor(windowRef);
    }
}
```

```

    else
    {
        TEdesactivate(textEditStrucHdl);
        DeactivateControl(docStrucPtr->vScrollbarRef);
    }
}

// ***** doNewDocWindow

WindowRef doNewDocWindow(void)
{
    WindowRef      windowRef;
    OSStatus        osError;
    Rect            contentRect = { 100,100,400,595 };
    WindowAttributes attributes = kWindowStandardHandlerAttribute |
                                kWindowStandardDocumentAttributes;

    docStructurePointer docStrucPtr;
    Rect                portRect, destAndViewRect;
    EventTypeSpec        windowEvents[] = { { kEventClassWindow, kEventWindowDrawContent },
                                             { kEventClassWindow, kEventWindowActivated },
                                             { kEventClassWindow, kEventWindowDeactivated },
                                             { kEventClassWindow, kEventWindowClickContentRgn },
                                             { kEventClassWindow, kEventWindowClose },
                                             { kEventClassMouse, kEventMouseDown },
                                             { kEventClassKeyboard, kEventRawKeyDown },
                                             { kEventClassKeyboard, kEventRawKeyRepeat } };

    osError = CreateNewWindow(kDocumentWindowClass, attributes, &contentRect, &windowRef);
    if (osError != noErr)
    {
        doErrorAlert(eWindow);
        return NULL;
    }

    ChangeWindowAttributes(windowRef, 0, kWindowResizableAttribute);
    RepositionWindow(windowRef, NULL, kWindowCascadeOnMainScreen);
    SetWindowTitle(windowRef, "\puntitled");
    SetPortWindowPort(windowRef);
    TextSize(10);
    if (!(docStrucPtr = (docStructurePointer) NewPtr(sizeof(docStructure))))
    {
        doErrorAlert(eDocStructure);
        return NULL;
    }

    SetWRefCon(windowRef, (SInt32) docStrucPtr);
    SetWindowProxyCreatorAndType(windowRef, 0, 'TEXT', kUserDomain);

    InstallWindowEventHandler(windowRef, doGetHandlerUPP(), GetEventTypeCount(windowEvents),
                             windowEvents, 0, NULL);

    gNumberOfWindows ++;
}

```

```

docStrucPtr->windowRef      = windowRef;
docStrucPtr->windowTouched = false;
docStrucPtr->preDragText    = NULL;
docStrucPtr->VScrollbarRef  = GetNewControl(rVScrollbar,windowRef);

GetWindowPortBounds(windowRef,&portRect);
destAndViewRect = portRect;
destAndViewRect.right -= 15;
InsetRect(&destAndViewRect,2,2);

if(!(docStrucPtr->textEditStrucHdl = TENew(&destAndViewRect,&destAndViewRect)))
{
    DisposeWindow(windowRef);
    gNumberOfWindows --;
    DisposePtr((Ptr) docStrucPtr);
    doErrorAlert(eTextEdit);
    return NULL;
}

TESetClickLoop(gCustomClickLoopUPP,docStrucPtr->textEditStrucHdl);
TEAutoView(true,docStrucPtr->textEditStrucHdl);
TEFeatureFlag(teFOutlineHilite,teBitSet,docStrucPtr->textEditStrucHdl);

if(osError = InstallTrackingHandler(gDragTrackingHandlerUPP,windowRef,docStrucPtr))
{
    DisposeWindow(windowRef);
    gNumberOfWindows --;
    DisposePtr((Ptr) docStrucPtr);
    doErrorAlert(eDragHandler);
    return NULL;
}

if(osError = InstallReceiveHandler(gDragReceiveHandlerUPP,windowRef,docStrucPtr))
{
    RemoveTrackingHandler(gDragTrackingHandlerUPP,windowRef);
    DisposeWindow(windowRef);
    gNumberOfWindows --;
    DisposePtr((Ptr) docStrucPtr);
    doErrorAlert(eDragHandler);
    return NULL;
}

ShowWindow(windowRef);

return windowRef;
}

// ***** doGetHandlerUPP

EventHandlerUPP doGetHandlerUPP(void)
{
    static EventHandlerUPP windowEventHandlerUPP;

```

```

    if(windowEventHandlerUPP == NULL)
        windowEventHandlerUPP = NewEventHandlerUPP((EventHandlerProcPtr) windowEventHandler);

    return windowEventHandlerUPP;
}

// ***** customClickLoop

Boolean customClickLoop(void)
{
    WindowRef      windowRef;
    docStructurePointer docStrucPtr;
    TEHandle        textEditStrucHdl;
    GrafPtr         oldPort;
    RgnHandle        oldClip;
    Rect            tempRect, portRect;
    Point            mouseXY;
    SInt16           linesToScroll = 0;

    windowRef = FrontWindow();
    docStrucPtr = (docStructurePointer) (GetWRefCon(windowRef));
    textEditStrucHdl = docStrucPtr->textEditStrucHdl;

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);
    oldClip = NewRgn();
    GetClip(oldClip);
    SetRect(&tempRect, -32767, -32767, 32767, 32767);
    ClipRect(&tempRect);

    GetMouse(&mouseXY);
    GetWindowPortBounds(windowRef, &portRect);

    if(mouseXY.v < portRect.top)
    {
        linesToScroll = 1;
        doSetScrollbarValue(docStrucPtr->vScrollbarRef, &linesToScroll);
        if(linesToScroll != 0)
            TEScroll(0, linesToScroll * ((*textEditStrucHdl)->lineHeight), textEditStrucHdl);
    }
    else if(mouseXY.v > portRect.bottom)
    {
        linesToScroll = -1;
        doSetScrollbarValue(docStrucPtr->vScrollbarRef, &linesToScroll);
        if(linesToScroll != 0)
            TEScroll(0, linesToScroll * ((*textEditStrucHdl)->lineHeight), textEditStrucHdl);
    }

    SetClip(oldClip);
    DisposeRgn(oldClip);
    SetPort(oldPort);

    return true;
}

```

```
// ***** doSetScrollBarValue

void doSetScrollBarValue(ControlRef controlRef, SInt16 *linesToScroll)
{
    SInt16 controlValue, controlMax;

    controlValue = GetControlValue(controlRef);
    controlMax = GetControlMaximum(controlRef);

    *linesToScroll = controlValue - *linesToScroll;
    if(*linesToScroll < 0)
        *linesToScroll = 0;
    else if(*linesToScroll > controlMax)
        *linesToScroll = controlMax;

    SetControlValue(controlRef, *linesToScroll);
    *linesToScroll = controlValue - *linesToScroll;
}

// ***** doAdjustMenus

void doAdjustMenus(void)
{
    MenuRef          fileMenuRef, editMenuRef;
    WindowRef        windowRef;
    docStructurePointer docStrucPtr;
    TEHandle          textEditStrucHdl;
    ScrapRef          scrapRef;
    OSStatus          osError;
    ScrapFlavorFlags  scrapFlavorFlags;

    fileMenuRef = GetMenuRef(mFile);
    editMenuRef = GetMenuRef(mEdit);

    if(gNumberOfWindows > 0)
    {
        windowRef = FrontWindow();
        docStrucPtr = (docStructurePointer) (GetWRefCon(windowRef));
        textEditStrucHdl = docStrucPtr->textEditStrucHdl;

        EnableMenuItem(fileMenuRef, iClose);

        if(gEnableDragUndoRedoItem)
        {
            EnableMenuItem(editMenuRef, iUndo);
            if(gUndoFlag)
                SetMenuItemText(editMenuRef, iUndo, "\pUndo Drag & Drop");
            else
                SetMenuItemText(editMenuRef, iUndo, "\pRedo Drag & Drop");
        }
        else
        {
            DisableMenuItem(editMenuRef, iUndo);
            SetMenuItemText(editMenuRef, iUndo, "\pRedo Drag & Drop");
        }
    }
}
```



```

    if ((*textEditStrucHdl)->selStart < (*textEditStrucHdl)->selEnd)
    {
        EnableMenuItem(editMenuRef,iCut);
        EnableMenuItem(editMenuRef,iCopy);
        EnableMenuItem(editMenuRef,iClear);
    }
    else
    {
        DisableMenuItem(editMenuRef,iCut);
        DisableMenuItem(editMenuRef,iCopy);
        DisableMenuItem(editMenuRef,iClear);
    }

    GetCurrentScrap(&scrapRef);

    osError = GetScrapFlavorFlags(scrapRef,kScrapFlavorTypeText,&scrapFlavorFlags);
    if(osError == noErr)
        EnableMenuItem(editMenuRef,iPaste);
    else
        DisableMenuItem(editMenuRef,iPaste);

    if ((*textEditStrucHdl)->teLength > 0)
    {
        EnableMenuItem(fileMenuRef,iSaveAs);
        EnableMenuItem(editMenuRef,iSelectAll);
    }
    else
    {
        DisableMenuItem(fileMenuRef,iSaveAs);
        DisableMenuItem(editMenuRef,iSelectAll);
    }
}
else
{
    DisableMenuItem(fileMenuRef,iClose);
    DisableMenuItem(fileMenuRef,iSaveAs);
    DisableMenuItem(editMenuRef,iClear);
    DisableMenuItem(editMenuRef,iSelectAll);
}

DrawMenuBar();
}

// ***** doMenuChoice *****
void doMenuChoice(MenuID menuID,MenuItemIndex menuItem)
{
    if(menuID == 0)
        return;

    switch(menuID)
    {
        case mAppleApplication:
            if(menuItem == iAbout)
                SysBeep(10);
            break;
    }
}

```

```

    case mFile:
        doFileMenu(menuItem);
        break;

    case mEdit:
        doEditMenu(menuItem);
        break;
}

// ***** doFileMenu

void doFileMenu(MenuBarItem menuItem)
{
    docStructurePointer docStrucPtr;
    TEHandle             textEditStrucHdl;

    switch(menuItem)
    {
        case iNew:
            doNewDocWindow();
            break;

        case iOpen:
            doOpenCommand();
            doAdjustScrollbar(FrontWindow());
            break;

        case iClose:
            doCloseWindow(FrontWindow());
            break;

        case iSaveAs:
            docStrucPtr = (docStructurePointer) (GetWRefCon(FrontWindow()));
            textEditStrucHdl = docStrucPtr->textEditStrucHdl;
            doSaveAsFile(textEditStrucHdl);
            break;
    }
}

// ***** doEditMenu

void doEditMenu(MenuBarItem menuItem)
{
    WindowRef          windowRef;
    docStructurePointer docStrucPtr;
    TEHandle            textEditStrucHdl;
    SInt32              totalSize, contigSize, newSize;
    SInt16              selectionLength;
    ScrapRef            scrapRef;
    Size                sizeOfTextData;

    windowRef = FrontWindow();
    docStrucPtr = (docStructurePointer) (GetWRefCon(windowRef));
    textEditStrucHdl = docStrucPtr->textEditStrucHdl;

```

```

switch(menuItem)
{
    case iUndo:
        doUndoRedoDrag(windowRef);
        break;

    case iCut:
        if(ClearCurrentScrap() == noErr)
        {
            PurgeSpace(&totalSize,&contigSize);
            selectionLength = doGetSelectLength(textEditStrucHdl);
            if(selectionLength > contigSize)
                doErrorAlert(eNoSpaceCut);
            else
            {
                TECut(textEditStrucHdl);
                doAdjustScrollbar(windowRef);
                if(TEToScrap() != noErr)
                    ClearCurrentScrap();
            }
        }
        break;

    case iCopy:
        if(ClearCurrentScrap() == noErr)
        {
            TECopy(textEditStrucHdl);
            if(TEToScrap() != noErr)
                ClearCurrentScrap();
        }
        break;

    case iPaste:
        GetCurrentScrap(&scrapRef);
        GetScrapFlavorSize(scrapRef,kScrapFlavorTypeText,&sizeOfTextData);
        newSize = (*textEditStrucHdl)->teLength + sizeOfTextData;
        if(newSize > kMaxTELength)
            doErrorAlert(eNoSpacePaste);
        else
        {
            if(TEToScrap() == noErr)
            {
                TEPaste(textEditStrucHdl);
                doAdjustScrollbar(windowRef);
            }
        }
        break;

    case iClear:
        TEDelete(textEditStrucHdl);
        doAdjustScrollbar(windowRef);
        break;
}

```

```

        case iSelectAll:
            TETestSelect(0, (*textEditStrucHdl)->teLength, textEditStrucHdl);
            break;
    }
}

// ***** doGetSelectLength

SInt16 doGetSelectLength(TEHandle textEditStrucHdl)
{
    SInt16 selectionLength;

    selectionLength = (*textEditStrucHdl)->selEnd - (*textEditStrucHdl)->selStart;
    return selectionLength;
}

// ***** doAdjustScrollbar

void doAdjustScrollbar(WindowRef windowRef)
{
    docStructurePointer docStrucPtr;
    TEHandle            textEditStrucHdl;
    SInt16              numberOfLines, controlMax, controlValue;

    docStrucPtr = (docStructurePointer) (GetWRefCon(windowRef));
    textEditStrucHdl = docStrucPtr->textEditStrucHdl;

    numberOfLines = (*textEditStrucHdl)->nLines;
    if ((*textEditStrucHdl)->hText + (*textEditStrucHdl)->teLength - 1) == kReturn)
        numberOfLines += 1;

    controlMax = numberOfLines - (((*textEditStrucHdl)->viewRect.bottom -
                                   (*textEditStrucHdl)->viewRect.top) /
                                   (*textEditStrucHdl)->lineHeight);
    if (controlMax < 0)
        controlMax = 0;
    SetControlMaximum(docStrucPtr->vScrollbarRef, controlMax);

    controlValue = ((*textEditStrucHdl)->viewRect.top - (*textEditStrucHdl)->destRect.top) /
                   (*textEditStrucHdl)->lineHeight;
    if (controlValue < 0)
        controlValue = 0;
    else if (controlValue > controlMax)
        controlValue = controlMax;

    SetControlValue(docStrucPtr->vScrollbarRef, controlValue);

    SetControlViewSize(docStrucPtr->vScrollbarRef, (*textEditStrucHdl)->viewRect.bottom -
                                                         (*textEditStrucHdl)->viewRect.top);

    TEScroll(0, ((*textEditStrucHdl)->viewRect.top - (*textEditStrucHdl)->destRect.top) -
              (GetControlValue(docStrucPtr->vScrollbarRef) *
               (*textEditStrucHdl)->lineHeight), textEditStrucHdl);
}

```

```
// ***** doAdjustCursor

void doAdjustCursor(WindowRef windowRef)
{
    GrafPtr          oldPort;
    RgnHandle         arrowRegion, iBeamRegion, hiliteRgn;
    Rect             portRect, cursorRect;
    docStructurePointer docStrucPtr;
    Point            offset, mouseXY;

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    arrowRegion = NewRgn();
    iBeamRegion = NewRgn();
    hiliteRgn   = NewRgn();
    SetRectRgn(arrowRegion, -32768, -32768, 32766, 32766);

    GetWindowPortBounds(windowRef, &portRect);
    cursorRect = portRect;
    cursorRect.right -= 15;
    LocalToGlobal(&topLeft(cursorRect));
    LocalToGlobal(&botRight(cursorRect));

    RectRgn(iBeamRegion, &cursorRect);
    DiffRgn(arrowRegion, iBeamRegion, arrowRegion);

    docStrucPtr = (docStructurePointer) (GetWRefCon(windowRef));
    TEGetHiliteRgn(hiliteRgn, docStrucPtr->textEditStrucHdl);
    LocalToGlobal(&topLeft(portRect));
    offset = topLeft(portRect);
    OffsetRgn(hiliteRgn, offset.h, offset.v);
    DiffRgn(iBeamRegion, hiliteRgn, iBeamRegion);

    GetGlobalMouse(&mouseXY);

    if(PtInRgn(mouseXY, iBeamRegion))
        SetThemeCursor(kThemeIBeamCursor);
    else if(PtInRgn(mouseXY, hiliteRgn))
        SetThemeCursor(kThemeArrowCursor);
    else
        SetThemeCursor(kThemeArrowCursor);

    DisposeRgn(arrowRegion);
    DisposeRgn(iBeamRegion);
    DisposeRgn(hiliteRgn);

    SetPort(oldPort);
}
```

```
// ***** doCloseWindow

void doCloseWindow(WindowRef windowRef)
{
    docStructurePointer docStrucPtr;

    docStrucPtr = (docStructurePointer) (GetWRefCon(windowRef));

    DisposeControl(docStrucPtr->vScrollbarRef);
    TEDispose(docStrucPtr->textEditStrucHdl);
    DisposePtr((Ptr) docStrucPtr);

    if(docStrucPtr->preDragText == NULL)
        DisposeHandle(docStrucPtr->preDragText);

    RemoveTrackingHandler(gDragTrackingHandlerUPP,windowRef);
    RemoveReceiveHandler(gDragReceiveHandlerUPP,windowRef);

    DisposeWindow(windowRef);

    gNumberOfWindows --;
}

// ***** doSaveAsFile

void doSaveAsFile(TEHandle textEditStrucHdl)
{
    OSErr          osError = noErr;
    NavDialogOptions dialogOptions;
    NavEventUPP     navEventFunctionUPP;
    WindowRef       windowRef;
    OSType          fileType;
    NavReplyRecord   navReplyStruc;
    AEKeyword        theKeyword;
    DescType         actualType;
    FSSpec           fileSpec;
    SInt16           fileRefNum;
    Size             actualSize;
    SInt32           dataLength;
    Handle           editTextHdl;

    osError = NavGetDefaultDialogOptions(&dialogOptions);

    if(osError == noErr)
    {
        windowRef = FrontWindow();

        fileType = 'TEXT';

        navEventFunctionUPP = NewNavEventUPP((NavEventProcPtr) navEventFunction);
        osError = NavPutFile(NULL,&navReplyStruc,&dialogOptions,navEventFunctionUPP,fileType,
                             kFileCreator,NULL);
        DisposeNavEventUPP(navEventFunctionUPP);
    }
}
```

```

if(navReplyStruc.validRecord && osError == noErr)
{
    if((osError = AEGetNthPtr(&(navReplyStruc.selection),1,typeFSS,&theKeyword,
        &actualType,&fileSpec,sizeof(fileSpec),&actualSize)) == noErr)

    {
        if(!navReplyStruc.replacing)
        {
            osError = FSpCreate(&fileSpec,kFileCreator,fileType,navReplyStruc.keyScript);
            if(osError != noErr)
            {
                NavDisposeReply(&navReplyStruc);
            }
        }

        if(osError == noErr)
            osError = FSpOpenDF(&fileSpec,fsRdWrPerm,&fileRefNum);

        if(osError == noErr)
        {
            SetWTitle(windowRef,fileSpec.name);
            dataLength = (*textEditStrucHdl)->teLength;
            editTextHdl = (*textEditStrucHdl)->hText;
            FSWrite(fileRefNum,&dataLength,*editTextHdl);
        }

        NavCompleteSave(&navReplyStruc,kNavTranslateInPlace);
    }

    NavDisposeReply(&navReplyStruc);
}
}

// ***** doOpenCommand

void doOpenCommand(void)
{
    OSErr          osError = noErr;
    NavDialogOptions dialogOptions;
    NavEventUPP     navEventFunctionUPP;
    NavReplyRecord   navReplyStruc;
    SInt32           index, count;
    AEKeyword        theKeyword;
    DescType         actualType;
    FSSpec           fileSpec;
    Size             actualSize;
    FileInfo          fileInfo;

    osError = NavGetDefaultDialogOptions(&dialogOptions);

```

```

if(osError == noErr)
{
    navEventFunctionUPP = NewNavEventUPP((NavEventProcPtr) navEventFunction);
    osError = NavGetFile(NULL,&navReplyStruc,&dialogOptions,navEventFunctionUPP,NULL,NULL,
        NULL,NULL);
    DisposeNavEventUPP(navEventFunctionUPP);

    if(osError == noErr && navReplyStruc.validRecord)
    {
        if(osError == noErr)
        {
            if(osError == noErr)
            {
                osError = AECOUNTITEMS(&(navReplyStruc.selection),&count);

                for(index=1;index<=count;index++)
                {
                    osError = AEGETNTHPTR(&(navReplyStruc.selection),index,typeFSS,&theKeyword,
                        &actualType,&fileSpec,sizeof(fileSpec),&actualSize);

                    {
                        if((osError = FSPGETFINFO(&fileSpec,&fileInfo)) == noErr)
                            doOpenFile(fileSpec);
                    }
                }
            }
        }

        NavDisposeReply(&navReplyStruc);
    }
}

// ***** doOpenFile

void doOpenFile(FSSpec fileSpec)
{
    WindowRef          windowRef;
    docStructurePointer docStrucPtr;
    TEHandle            textEditStrucHdl;
    SInt16              fileRefNum;
    SInt32              textLength;
    Handle              textBuffer;

    if((windowRef = doNewDocWindow()) == NULL)
        return;

    docStrucPtr = (docStructurePointer) (GetWRefCon(windowRef));
    textEditStrucHdl = docStrucPtr->textEditStrucHdl;

    SetWTitle(windowRef,fileSpec.name);

    FSpOpenDF(&fileSpec,fsCurPerm,&fileRefNum);

```





```
// *****
// StartAndTrackDrag.c
// *****

// ..... includes

#include "Drag.h"

// ..... global variables

Boolean gCursorInContent, gCanAcceptItems, gCaretShowFlag;
SInt16 gInsertPosition, gLastOffset, gCaretOffset;
UInt32 gSystemCaretTime, gCaretStartTime;

extern Boolean gRunningOnX;

// ***** doStartDrag

OSErr doStartDrag(EventRecord *eventStrucPtr, RgnHandle hiliteRgnHdl, TEHandle textEditStrucHdl)
{
    OSErr      osError;
    DragReference dragRef;
    Rect        originalHiliteRect, zeroedHiliteRect;
    RgnHandle    maskRgnHdl;
    Point        offsetPoint;
    QDErr        qdError;
    CGrafPtr      savedPortPtr;
    GDHandle      saveDeviceHdl;
    GWorldPtr      dragGWorldPtr = NULL;
    PixMapHandle   dragPixMapHdl, windPixMapHdl;
    RgnHandle      dragRgnHdl, tempRgnHdl;

    // ..... create new drag

    if(osError = NewDrag(&dragRef))
        return osError;

    // ..... add 'TEXT' flavor

    osError = AddDragItemFlavor(dragRef, 1, 'TEXT',
                               ((*textEditStrucHdl)->hText) + (*textEditStrucHdl)->selStart,
                               ((*textEditStrucHdl)->selEnd - (*textEditStrucHdl)->selStart, 0);

    // ..... get and set drag image for translucent drag and drop

    if(!gRunningOnX)
    {
        maskRgnHdl = dragRgnHdl = tempRgnHdl = NULL;

        GetRegionBounds(hiliteRgnHdl, &originalHiliteRect);
        zeroedHiliteRect = originalHiliteRect;
        OffsetRect(&zeroedHiliteRect, -originalHiliteRect.left, -originalHiliteRect.top);

        GetGWorld(&savedPortPtr, &saveDeviceHdl);
    }
}
```

```

qdError = NewGWorld(&dragGWorldPtr,8,&zeroedHiliteRect,NULL,NULL,0);
if(dragGWorldPtr != NULL && qdError == noErr)
{
    SetGWorld(dragGWorldPtr,NULL);
    EraseRect(&zeroedHiliteRect);

    dragPixMapHdl = GetGWorldPixMap(dragGWorldPtr);
    LockPixels(dragPixMapHdl);
    windPixMapHdl = GetGWorldPixMap(savedPortPtr);

    CopyBits((BitMap *) *windPixMapHdl,(BitMap *) *dragPixMapHdl,
             &originalHiliteRect,&zeroedHiliteRect,srcCopy,NULL);

    UnlockPixels(dragPixMapHdl);
    SetGWorld(savedPortPtr,saveDeviceHdl);

    maskRgnHdl = NewRgn();
    if(maskRgnHdl != NULL)
    {
        CopyRgn(hiliteRgnHdl,maskRgnHdl);
        OffsetRgn(maskRgnHdl,-originalHiliteRect.left,-originalHiliteRect.top);

        SetPt(&offsetPoint,originalHiliteRect.left,originalHiliteRect.top);
        LocalToGlobal(&offsetPoint);

        SetDragImage(dragRef,dragPixMapHdl,maskRgnHdl,offsetPoint,kDragStandardTranslucency);
    }
}

// ..... get drag region

dragRgnHdl = NewRgn();
if(dragRgnHdl == NULL)
    return MemError();

CopyRgn(hiliteRgnHdl,dragRgnHdl);
SetPt(&offsetPoint,0,0);
LocalToGlobal(&offsetPoint);
OffsetRgn(dragRgnHdl,offsetPoint.h,offsetPoint.v);

tempRgnHdl = NewRgn();
if(tempRgnHdl == NULL)
    return MemError();

CopyRgn(dragRgnHdl,tempRgnHdl);
InsetRgn(tempRgnHdl,1,1);
DiffRgn(dragRgnHdl,tempRgnHdl,dragRgnHdl);
DisposeRgn(tempRgnHdl);

// ..... perform the drag

osError = TrackDrag(dragRef,eventStrucPtr,dragRgnHdl);
if(osError != noErr && osError != userCanceledErr)
    return osError;

```

```

if(dragRef)        DisposeDrag(dragRef);
if(maskRgnHdl)     DisposeRgn(maskRgnHdl);
if(dragGWorldPtr)  DisposeGWorld(dragGWorldPtr);
if(dragRgnHdl)     DisposeRgn(dragRgnHdl);
if(tempRgnHdl)     DisposeRgn(tempRgnHdl);

return noErr;
}

// ***** dragTrackingHandler

OSErr dragTrackingHandler(DragTrackingMessage trackingMessage, WindowRef windowRef,
                          void *handlerRefCon, DragRef dragRef)
{
    docStructurePointer docStrucPtr;
    DragAttributes       dragAttributes;
    UInt32               theTime;
    UInt16               numberOfDragItems, index;
    ItemReference         itemRef;
    OSErr                result;
    FlavorFlags          flavorFlags;
    Point                mousePt, localMousePt;
    RgnHandle             windowHiliteRgn;
    Rect                 correctedViewRect;
    SInt16               theOffset;

    if((trackingMessage != kDragTrackingEnterHandler) && !gCanAcceptItems)
        return noErr;

    docStrucPtr = (docStructurePointer) handlerRefCon;

    GetDragAttributes(dragRef, &dragAttributes);
    gSystemCaretTime = GetCaretTime();
    theTime = TickCount();

    switch(trackingMessage)
    {
        // ..... enter handler

        case kDragTrackingEnterHandler:
            gCanAcceptItems = true;

            CountDragItems(dragRef, &numberOfDragItems);

            for(index=1; index <= numberOfDragItems; index++)
            {
                GetDragItemReferenceNumber(dragRef, index, &itemRef);
                result = GetFlavorFlags(dragRef, itemRef, 'TEXT', &flavorFlags);
                if(result != noErr)
                {
                    gCanAcceptItems = false;
                    break;
                }
            }
            break;
    }
}

```

```

// ..... enter window

case kDragTrackingEnterWindow:
    gCaretStartTime = theTime;
    gCaretOffset     = gLastOffset = -1;
    gCaretShowFlag   = true;
    gCursorInContent = false;
    break;

// ..... in window

case kDragTrackingInWindow:

    GetDragMouse(dragRef,&mousePt,NULL);
    localMousePt = mousePt;
    GlobalToLocal(&localMousePt);

    if(dragAttributes & kDragHasLeftSenderWindow)
    {
        if(PtInRect(localMousePt,&(**(docStrucPtr->textEditStrucHdl)).viewRect))
        {
            if(!gCursorInContent)
            {
                windowHiliteRgn = NewRgn();
                correctedViewRect = (**(docStrucPtr->textEditStrucHdl)).viewRect;
                InsetRect(&correctedViewRect,-2,-2);
                RectRgn(windowHiliteRgn,&correctedViewRect);
                ShowDragHilite(dragRef,windowHiliteRgn,true);
                DisposeRgn(windowHiliteRgn);
            }
            gCursorInContent = true;
        }
        else
        {
            if(gCursorInContent)
                HideDragHilite(dragRef);
            gCursorInContent = false;
        }
    }

    // ... .. start caret drawing stuff, first get the offset into the text

    theOffset = doGetOffset(mousePt,docStrucPtr->textEditStrucHdl);

    // ... .. if in sender window, defeat caret drawing in selection

    if(dragAttributes & kDragInsideSenderWindow)
    {
        if((theOffset >= (*(docStrucPtr->textEditStrucHdl))->selStart) &&
            (theOffset <= (*(docStrucPtr->textEditStrucHdl))->selEnd))
        {
            theOffset = -1;
        }
    }
}

```

```

// ... .. save the offset to a global for use by dragReceiveHandler
gInsertPosition = theOffset;

// ... .. if offset has changed, reset the caret flashing timer
if(theOffset != gLastOffset)
{
    gCaretStartTime = theTime;
    gCaretShowFlag = true;
}

gLastOffset = theOffset;

// ... .. if caret-flashing interval has elapsed, toggle caret "show" flag, reset timer
if(theTime - gCaretStartTime > gSystemCaretTime)
{
    gCaretShowFlag = !gCaretShowFlag;
    gCaretStartTime = theTime;
}

// ... .. if caret "show" flag is off, set variable to defeat caret drawing
if(!gCaretShowFlag)
    theOffset = -1;

// ... .. if offset has changed, erase previous caret, draw new caret at current offset
if(theOffset != gCaretOffset)
{
    // ... .. if first pass this window, don't erase, otherwise erase at old offset

    if(gCaretOffset != -1)
        doDrawCaret(gCaretOffset, docStrucPtr->textEditStrucHdl);

    // ... .. if "show" flag says show, draw caret at current offset

    if(theOffset != -1)
        doDrawCaret(theOffset, docStrucPtr->textEditStrucHdl);
}

gCaretOffset = theOffset;

break;

// ..... leave window
case kDragTrackingLeaveWindow:

    if(gCaretOffset != -1)
    {
        doDrawCaret(gCaretOffset, docStrucPtr->textEditStrucHdl);
        gCaretOffset = -1;
    }

```

```

        if(gCursorInContent && dragAttributes & kDragHasLeftSenderWindow)
            HideDragHilite(dragRef);

        break;

// ..... leave handler

    case kDragTrackingLeaveHandler:
        break;
}

return noErr;
}

// ***** doGetOffset

SInt16 doGetOffset(Point mousePt,TEHandle textEditStrucHdl)
{
    WindowRef windowRef;
    SInt16 theOffset;
    Point thePoint;

    theOffset = -1;

    if(FindWindow(mousePt,&windowRef) == inContent)
    {
        SetPortWindowPort(windowRef);
        GlobalToLocal(&mousePt);

        if(PtInRect(mousePt,&((*textEditStrucHdl)->viewRect)))
        {
            theOffset = TEGetOffset(mousePt,textEditStrucHdl);
            thePoint = TEGetPoint(theOffset - 1,textEditStrucHdl);

            if((theOffset) &&
                (doIsOffsetAtLineStart(theOffset,textEditStrucHdl)) &&
                ((*textEditStrucHdl)->hText)[theOffset - 1] != 0x0D) &&
                (thePoint.h < mousePt.h))
            {
                theOffset--;
            }
        }
    }

    return theOffset;
}

// ***** doIsOffsetAtLineStart

SInt16 doIsOffsetAtLineStart(SInt16 offset,TEHandle textEditStrucHdl)
{
    SInt16 line = 0;

```

```

if((*textEditStrucHdl)->teLength == 0)
    return(true);

if(offset >= (*textEditStrucHdl)->teLength)
    return((*((*textEditStrucHdl)->hText))[( *textEditStrucHdl)->teLength - 1] == 0x0D);

while((*textEditStrucHdl)->lineStarts[line] < offset)
    line++;

return ((*textEditStrucHdl)->lineStarts[line] == offset);
}

// ***** doDrawCaret

void doDrawCaret(SInt16 theOffset,TEHandle textEditStrucHdl)
{
    Point thePoint;
    SInt16 theLine, lineHeight;

    thePoint = TEGetPoint(theOffset,textEditStrucHdl);
    theLine = doGetLine(theOffset,textEditStrucHdl);

    if((theOffset == (*textEditStrucHdl)->teLength) &&
        ((*textEditStrucHdl)->hText))[( *textEditStrucHdl)->teLength - 1] == 0x0D)
    {
        thePoint.v += TEGetHeight(theLine,theLine,textEditStrucHdl);
    }

    PenMode(patXor);
    lineHeight = TEGetHeight(theLine,theLine,textEditStrucHdl);
    MoveTo(thePoint.h - 1,thePoint.v - 1);
    Line(0,1 - lineHeight);

    PenNormal();
}

// ***** doGetLine

SInt16 doGetLine(SInt16 theOffset,TEHandle textEditStrucHdl)
{
    SInt16 theLine = 0;

    if(theOffset > (*textEditStrucHdl)->teLength)
        return ((*textEditStrucHdl)->nLines);

    while((*textEditStrucHdl)->lineStarts[theLine] < theOffset)
        theLine++;

    return theLine;
}

```



```

// *****
// ReceiveAndUndoDrag.c
// *****

// ..... includes

#include "Drag.h"

// ..... global variables

extern Boolean gEnableDragUndoRedoItem;
extern Boolean gUndoFlag;
extern Boolean gCanAcceptItems;
extern SInt16 gInsertPosition, gCaretOffset;

// ***** dragReceiveHandler

OSErr dragReceiveHandler(WindowRef windowRef, void *handlerRefCon, DragRef dragRef)
{
    docStructurePointer docStrucPtr;
    TEHandle            textEditStrucHdl;
    SInt32              totalTextStart;
    Size               totalTextSize;
    Boolean             wasActive, moveText, gotUndoMemory = false;
    DragAttributes      dragAttributes;
    SInt16              mouseDownModifiers, mouseUpModifiers, selStart, selEnd;
    UInt16              numberOfDragItems, index;
    ItemReference       itemReference;
    OSErr               osError;
    Size               textSize;
    Ptr                textDataPtr;
    SInt32              additionalChars;

    if(!gCanAcceptItems || (gInsertPosition == -1))
        return dragNotAcceptedErr;

    docStrucPtr = (docStructurePointer) handlerRefCon;
    textEditStrucHdl = docStrucPtr->textEditStrucHdl;

    // ... set graphics port to this window's port and, if necessary, activate text edit structure

    SetPortWindowPort(windowRef);

    wasActive = (*textEditStrucHdl)->active != 0;
    if(!wasActive)
        TEActivate(textEditStrucHdl);

    // ..... get drag attributes and keyboard modifiers

    GetDragAttributes(dragRef, &dragAttributes);
    GetDragModifiers(dragRef, 0L, &mouseDownModifiers, &mouseUpModifiers);

```

```

// ... .. in case their are multiple items, save first insertion point for later TETSetSelect

totalTextStart = gInsertPosition;
totalTextSize = 0;

// ... .. for all items in drag, get 'TEXT' data, insert into this window's text edit structure

CountDragItems(dragRef,&numberOfDragItems);

for(index=1;index <= numberOfDragItems;index++)
{
    GetDragItemReferenceNumber(dragRef,index,&itemReference);

    osError = GetFlavorDataSize(dragRef,itemReference,'TEXT',&textSize);
    if(osError == noErr)
    {
        // ... if addition of drag to the text edit structure would exceed TextEdit limit, return

        if(((textEditStrucHdl)->teLength + textSize) > kMaxTELength)
            return dragNotAcceptedErr;

        // ... .. create nonrelocatable block and get the 'TEXT' data into it

        textDataPtr = NewPtr(textSize);
        if(textDataPtr == NULL)
            return dragNotAcceptedErr;

        GetFlavorData(dragRef,itemReference,'TEXT',textDataPtr,&textSize,0);

        // ... .. if caret or highlighting is on screen, remove it

        if(gCaretOffset != -1)
        {
            doDrawCaret(gCaretOffset,textEditStrucHdl);
            gCaretOffset = -1;
        }

        if(dragAttributes & kDragHasLeftSenderWindow)
            HideDragHilite(dragRef);

        // save current text and selection start/end for Undo, and set Redo/Undo menu item flags

        if(dragAttributes & kDragInsideSenderWindow)
        {
            gotUndoMemory = doSavePreInsertionText(docStrucPtr);
            if(gotUndoMemory)
            {
                gEnableDragUndoRedoItem = true;
                gUndoFlag = true;
            }
        }
        else
            gEnableDragUndoRedoItem = false;
    }
}

```

```

// ... .. if in sender window, ensure selected text is deleted if option key not down

moveText = (dragAttributes & kDragInsideSenderWindow) &&
            (!((mouseDownModifiers & optionKey) | (mouseUpModifiers & optionKey)));

if(moveText)
{
    selStart = (*textEditStrucHdl)->selStart;
    selEnd   = (*textEditStrucHdl)->selEnd;

    // ... .. extend selection by one chara if space charas just before and just after

    if(doIsWhiteSpaceAtOffset(selStart - 1, textEditStrucHdl) &&
        !doIsWhiteSpaceAtOffset(selStart, textEditStrucHdl) &&
        !doIsWhiteSpaceAtOffset(selEnd - 1, textEditStrucHdl) &&
        doIsWhiteSpaceAtOffset(selEnd, textEditStrucHdl))
    {
        if(doGetCharAtOffset(selEnd, textEditStrucHdl) == ' ')
            (*textEditStrucHdl)->selEnd++;
    }

    // if insertion is after selected text, move insertion point back by size of selection

    if(gInsertPosition > selStart)
    {
        selEnd = (*textEditStrucHdl)->selEnd;
        gInsertPosition -= (selEnd - selStart);
        totalTextStart -= (selEnd - selStart);
    }

    // ... .. delete the selection

    TDelete(textEditStrucHdl);
}

// ... .. insert the 'TEXT' data at the insertion point

additionalChars = doInsertTextAtOffset(gInsertPosition, textDataPtr, textSize,
                                       textEditStrucHdl);

// ... .. if inserting multiple blocks of text, update insertion point for next block

gInsertPosition += textSize + additionalChars;
totalTextSize += textSize + additionalChars;

// ... .. dispose of nonrelocatable block

DisposePtr(textDataPtr);
}
}

```

```

// ..... select total inserted text and adjust scrollbar

TESetSelect(totalTextStart,totalTextStart + totalTextSize,textEditStrucHdl);
doAdjustScrollbar(windowRef);

// ..... set window's "touched" flag, and save post-insert selection start and end for Redo

docStrucPtr->windowTouched = true;

if(dragAttributes & kDragInsideSenderWindow)
{
    docStrucPtr->postDropSelStart = totalTextStart;
    docStrucPtr->postDropSelEnd = totalTextStart + totalTextSize;
}

// ..... if text edit structure had to be activated earlier, deactivate it

if(!wasActive)
    TEDeactivate(textEditStrucHdl);

return noErr;
}

// ***** doIsWhiteSpaceAtOffset

Boolean doIsWhiteSpaceAtOffset(SInt16 offset,TEHandle textEditStrucHdl)
{
    char theChar;

    if((offset < 0) || (offset > (*textEditStrucHdl)->teLength - 1))
        return true;

    theChar = ((char *) ((*textEditStrucHdl)->hText))[offset];

    return (doIsWhiteSpace(theChar));
}

// ***** doIsWhiteSpace

Boolean doIsWhiteSpace(char theChar)
{
    return ((theChar == ' ') || (theChar == 0x0D));
}

// ***** doGetCharAtOffset

char doGetCharAtOffset(SInt16 offset,TEHandle textEditStrucHdl)
{
    if(offset < 0)
        return 0x0D;

    return (((char *) ((*textEditStrucHdl)->hText))[offset]);
}

```

```

// ***** doInsertTextAtOffset

SInt16 doInsertTextAtOffset(SInt16 textOffset,Ptr textDataPtr,SInt32 textSize,
                           TEHandle textEditStrucHdl)
{
    SInt16 charactersAdded = 0;

    if(textSize == 0)
        return charactersAdded;

    // ..... if inserting at end of word, and selection does not begin with a space, insert a space

    if(!doIsWhiteSpaceAtOffset(textOffset - 1,textEditStrucHdl) &&
        doIsWhiteSpaceAtOffset(textOffset,textEditStrucHdl) &&
        !doIsWhiteSpace(textDataPtr[0]))
    {
        TSetSelect(textOffset,textOffset,textEditStrucHdl);
        TEKey(' ',textEditStrucHdl);
        ++textOffset;
        ++charactersAdded;
    }

    // ... if inserting at beginning of word and selection does not end with a space, insert space

    if(doIsWhiteSpaceAtOffset(textOffset - 1,textEditStrucHdl) &&
        !doIsWhiteSpaceAtOffset(textOffset,textEditStrucHdl) &&
        !doIsWhiteSpace(textDataPtr[textSize - 1]))
    {
        TSetSelect(textOffset,textOffset,textEditStrucHdl);
        TEKey(' ',textEditStrucHdl);
        ++charactersAdded;
    }

    // ..... before inserting, set selection range to a zero

    TSetSelect(textOffset,textOffset,textEditStrucHdl);
    TEInsert(textDataPtr,textSize,textEditStrucHdl);

    return charactersAdded;
}

// ***** doSavePreInsertionText

Boolean doSavePreInsertionText(docStructurePointer docStrucPtr)
{
    OSErr osError;
    Size tempSize;
    Handle tempTextHdl;

    if(docStrucPtr->preDragText == NULL)
        docStrucPtr->preDragText = NewHandle(0);
}

```

```

tempTextHdl = (*(docStrucPtr->textEditStrucHdl))->hText;
tempSize = GetHandleSize(tempTextHdl);
SetHandleSize(docStrucPtr->preDragText,tempSize);
osError = MemError();
if(osError != noErr)
{
    doErrorAlert(eDragUndo);
    return false;
}

BlockMove(*tempTextHdl,*(docStrucPtr->preDragText),tempSize);

docStrucPtr->preDragSelStart = (*(docStrucPtr->textEditStrucHdl))->selStart;
docStrucPtr->preDragSelEnd   = (*(docStrucPtr->textEditStrucHdl))->selEnd;

return true;
}

// ***** doUndoRedoDrag

void doUndoRedoDrag(WindowRef windowRef)
{
    docStructurePointer docStrucPtr;
    Handle              tempTextHdl;
    Rect                portRect;

    docStrucPtr = (docStructurePointer) (GetWRefCon(windowRef));

    tempTextHdl = (*(docStrucPtr->textEditStrucHdl))->hText;
    (*(docStrucPtr->textEditStrucHdl))->hText = docStrucPtr->preDragText;
    docStrucPtr->preDragText = tempTextHdl;

    if(gUndoFlag)
    {
        (*(docStrucPtr->textEditStrucHdl))->selStart = docStrucPtr->preDragSelStart;
        (*(docStrucPtr->textEditStrucHdl))->selEnd   = docStrucPtr->preDragSelEnd;
    }
    else
    {
        (*(docStrucPtr->textEditStrucHdl))->selStart = docStrucPtr->postDropSelStart;
        (*(docStrucPtr->textEditStrucHdl))->selEnd   = docStrucPtr->postDropSelEnd;
    }

    gUndoFlag = !gUndoFlag;

    TECalText(docStrucPtr->textEditStrucHdl);
    GetWindowPortBounds(windowRef,&portRect);
    InvalWindowRect(windowRef,&portRect);
}

// *****

```

## Demonstration Program Drag Comments

When this program is run, the user should open the included document “Drag Document” and drag selections to other locations within the document, to other demonstration program windows, to the windows of other applications that accept ‘TEXT’ format data, and to the desktop and Finder windows (to create text clippings). The user should also drag text from the windows of other applications to the demonstration program’s windows.

The user should note the following:

- The highlighting of the demonstration program’s windows, and of the proxy icon, when items containing data of the ‘TEXT’ flavor are dragged over those windows.
- The movement of the insertion point caret with the cursor when items are dragged within the demonstration program’s windows, and the “hiding” of the caret when the drag originates in a demonstration program window and the cursor is moved over the selection.
- When dragging and dropping within the demonstration program’s windows:
  - The program’s implementation of “smart drag and drop.” (For example, if there is a space character immediately to the left and right of the selection, the deletion is extended to include the second space character, thus leaving a single space character between the two words that previously bracketed the selection.)
  - The availability and effect of the Undo/Redo item in the Edit menu.

The non-drag and drop aspects of this program are based on the demonstration program `MonoTextEdit` (Chapter 21), and the contents of `Drag.h` and `Drag.c` are very similar to the contents of `MonoTextEdit.c`. Accordingly, comments on the content of `Drag.h` and `Drag.c` are restricted to those areas where modifications have been made to the code contained in `MonoTextEdit.c`.

## Drag.h

### Defines

Three additional constants are established for drag and drop errors.

### typedefs

The `docStructure` data type has been extended to include fields to store the owning window’s window reference, a Boolean which is set to true when the contents of the window have been modified, and five fields to support drag-and-drop undo/redo.

## Drag.c

### Global Variables

`gDragTrackingHandlerUPP` and `gDragTrackingReceiverUPP` will be assigned universal procedure pointers to the tracking and receive handlers. `gEnableDragUndoRedoItem` and `gUndoFlag` will be used to control enabling/disabling of the Drag and Drop Undo/Redo item in the Edit menu.

### main

Universal procedure pointers are created for the drag tracking and receive handlers (`dragTrackingHandler` and `dragReceiveHandler`).

### windowEventHandler

When the `kWindowEventClickContentRgn` event type is received, `ConvertEventRefToEventRecord` is called and the address of the event record is passed in the call to `doInContent`, in addition to the mouse location and Shift key position. The address of an event record will be required by the call to `doStartDrag` in `doInContent`, and ultimately by the Drag Manager function `TrackDrag`.

### doKeyEvent

The global variable `gEnableDragUndoRedoItem` is set to false. This causes the Drag and Drop Undo/Redo item in the Edit menu to be disabled.

### doInContent

If the mouse-down was within the `TextEdit` view rectangle, `TEGetHiliteRgn` is called to attempt to get the highlight region. If there is a highlight region (that is, a selection), and if the mouse-down was within that region, `WaitMouseMoved` is called. `WaitMouseMoved` waits for either the mouse to move from the given initial mouse location or for the mouse button to be released. If the mouse moves away from the initial mouse location before the mouse button is released, `WaitMouseMoved` returns true, in which case the function `doStartDrag` is called.

### doNewDocWindow

A nonrelocatable block is created for the window's document structure.

`SetWindowProxyCreatorAndType` is called with 0 passed in the `fileCreator` parameter and 'TEXT' passed in the `fileType` parameter to cause the system's default icon for a document file to be displayed as the proxy icon. In this program, the proxy icon is used solely for the purpose of demonstrating proxy icon highlighting when `ShowDragHilite` is called to indicate that the window is a valid drag-and-drop target.



After `gNumberOfWindows` is incremented, four of the fields of the document structure are initialised.

Following the call to `TEFeatureFlag`, the drag tracking and receive handlers are installed on the window. (Note that the pointer to the window's document structure is passed in the `handlerRefCon` parameter of the installer functions.) If either installation is unsuccessful, the window and document structure are disposed of, the tracking handler also being removed in the case of a failure to install the receive handler.

### **doAdjustMenus**

When the global variable `gEnableDragUndoRedoItem` is set to true, the Drag and Drop Undo/Redo item is enabled, otherwise it is disabled. If the item is enabled, the global variable `gUndoFlag` controls the item text, setting it to either Undo or Redo.

### **doEditMenu**

If the Drag and Drop Undo/Redo item is chosen from the Edit menu, the function `doUndoRedoDrag` is called.

### **doAdjustCursor**

After the first call to `DiffRgn` (which establishes the arrow and IBeam regions), a pointer to the window's document structure is retrieved. This allows the handle to the window's `TextEdit` structure to be passed in a call to `TEGetHiliteRgn`. The region returned by `TEGetHiliteRgn` is in local coordinates, so the next three lines change it to global coordinates preparatory to a call to `DiffRgn`. The `DiffRgn` call, in effect, cuts the equivalent of the highlight region out of the IBeam region.

If the location of the mouse (returned by the call to `GetGlobalMouse`) is within the highlight region, the cursor is set to the arrow shape.

### **doCloseWindow**

If the `preDragText` field of the window's document structure does not contain NULL, `DisposeHandle` is called to release memory assigned in support of drag and drop redo/undo.

The calls to `RemoveTrackingHandler` and `RemoveReceiveHandler` remove the tracking and receive handlers before the window is disposed of.

## **StartAndTrackDrag.c**

### **doStartDrag**

The call to `NewDrag` allocates a new drag object.

The call to `AddDragItemFlavor` creates a drag item and adds a data flavor (specifically 'TEXT') to that item. Note that the item reference number passed is 1. If additional flavors were to be added to the item, this same item reference number would be passed in the additional calls to `AddDragItemFlavor`.

The next block gets and sets the drag image for translucent dragging, but executes only if the program is running on Mac OS 8/9. `GetRegionBounds` gets the bounding rectangle of the highlight region and `OffsetRect` adjusts the coordinates so that top left is 0,0. The call to `NewGWorld` creates an 8-bit deep offscreen graphics world the same size as this rectangle. `CopyBits` is then called to copy the highlight region area to the offscreen graphics world. The calls to `CopyRgn` and `OffsetRgn` create a region the same shape as the highlight region and adjusted so that the top left of the bounding rectangle is 0,0. The next two lines establish the offset point required by the following call to `SetDragImage`. This offset is required to move the pixel map in the offscreen graphics world to the global coordinates where the drag image is to initially appear. Finally, the handles to the offscreen graphics world and mask, the offset, and a constant specifying the required level of translucency are passed in the call to `SetDragImage`, which associates the image with the drag reference.

Any errors that might occur in setting up the translucent drag are not critical on Mac OS 8/9 because the next block creates the drag region for the alternative visual representation (a gray outline). On Mac OS X, this is the block that creates the gray outline. The received highlight region (which is in local coordinates) is copied to `dragRgnHdl`, which is then converted to global coordinates. This region, in turn, is copied to `tempRgnHdl`, which is then inset by one pixel. The call to `DiffRgn` subtracts the inset region from `dragRgnHdl`, leaving the latter with the same outline as the highlight region but only one pixel thick. The newly defined drag region is passed in the `theRegion` parameter of the call to `TrackDrag`.

`TrackDrag` performs the drag. During the drag, the Drag Manager follows the cursor on the screen with the translucent image (Mac OS 8/9) or gray outline (Mac OS X) and sends tracking messages to applications that have registered drag tracking handlers. When the user releases the mouse button, the Drag Manager calls any receive drop handlers that have been registered on the destination window.

The `TrackDrag` function returns `noErr` in situations where the user selected a destination for the drag and the destination received data from the Drag Manager. If the user drops over a non-aware application or the receiver does not accept any data from the Drag Manager, the Drag Manager automatically provides a “zoom back” animation and returns `userCanceledErr`. Thus the first return will execute only if an error other than `userCanceledErr` was returned.

### **dragTrackingHandler**

`dragTrackingHandler` is the drag tracking handler. It is a callback function.

Firstly, if the message received is not the enter handler message, and if it was determined at the time of receipt of the enter handler message that the drop cannot be accepted, the function returns immediately.

The pointer received in the `handlerRefCon` formal parameter is cast to a pointer to the window's document structure so that certain fields in this structure can later be accessed.

`GetDragAttributes` gets the current set of drag attribute flags. `GetCaretTime` gets the insertion point caret blink interval. `TickCount` gets the current system tick count. These latter two values will be used by the caret drawing code.

### ***Enter Handler***

Within the switch, the “enter handler” message is processed at the first case.

`CountDragItems` returns the number of items in the drag. Then, for each of the items in the drag, `GetDragItemReferenceNumber` is called to retrieve the item reference number, allowing the call to `GetFlavorFlags` to determine whether the item contains data of the ‘TEXT’ flavor. (`GetFlavorFlags` will return an error if the flavor does not exist.) `gCanAcceptItems` is assigned false if any item does not contain ‘TEXT’ data, meaning that the drag will only be accepted if all items contain data of the ‘TEXT’ flavor.

### ***Enter Window***

If the message is the “enter window” message, several global variables are initialized. These globals will be used when the “in window” message is received to control insertion point caret drawing and window highlighting.

### ***In Window***

Each time the “in window” message is received, `GetDragMouse` is called to get the current mouse location in global coordinates. The location is copied to a local `Point` variable, which is then converted from global to local coordinates.

The first if block executes if the drag has left the sender window. If the mouse cursor is within the window’s `TextEdit` view rectangle, and if `gCursorInContent` has previously been set to false (recall that it is set to false at the “enter window” message), `ShowDragHilite` is called to draw the standard drag and drop highlight around the view rectangle. `gCursorInContent` is then set to true to defeat further `ShowDragHilite` calls while the drag remains in this window.

If the mouse cursor is not within the window’s `TextEdit` view rectangle, and if `gCursorContent` has previously been set to true (causing a highlight draw), `HideDragHilite` is called to remove the highlighting, and `gCursorInContent` is set to false again so that `ShowDragHilite` is called if the drag moves back inside a view rectangle again.

With window highlighting attended to, the next task is to perform insertion point caret drawing.

The function `doGetOffset` takes the mouse location in global coordinates and the window’s `TextEdit` structure handle and returns the offset into the text corresponding to the mouse location. (Note that `doGetOffset` will return -1 if the cursor is not within the content region and the view rectangle of the window under the cursor. Note also that, if the cursor is within the content region of the window under the cursor, `doGetOffset` sets that window’s graphics port as the current port.)

If the drag is currently inside the sender window, and the offset returned by `doGetOffset` indicates that the cursor is within the `TextEdit` selection, the `Offset` is set to -1. As will be seen, this defeats the drawing of the caret when the cursor is within the selection.

The offset returned by `doGetOffset` is then saved to a global variable. As will be seen, the value assigned to this variable the last time the “in window” case executes (when the user releases the mouse button) will be used by the receive handler `dragReceiveHandler`.

If the offset has changed since the last time the “in window” case executed, the caret flashing timer is reset to the time the handler was entered this time around and the caret show/hide flag is set to “show.” The current offset is then assigned to the global `gLastOffset` preparatory to the execution of the “in window” case.

If the caret flashing interval has elapsed, the show/hide flag is toggled and the caret flashing timer is reset.

If the caret show/hide flag indicates that the caret should be “hidden,” the `Offset` will be set to -1 to defeat caret drawing.

If the offset has changed since the last execution of the “in window” case, the function for drawing/erasing the caret is called in certain circumstances. Firstly, if this is not the first execution of the “in window” case since entering the window, `doDrawCaret` is called to erase the caret previously drawn at the old offset. Secondly, if the show/hide flag indicates that the caret should be drawn, `doDrawCaret` is called to draw the caret at the current offset.

The global that stores the old offset is assigned the current offset before the case exits.

### **Leave Window**

When the “leave window” message is received, if the caret is on the screen, it is erased. If the window highlighting has previously been drawn, `HideDragHilite` is called to remove the highlighting.

### **doGetOffset**

`doGetOffset` is called by `dragTrackingHandler` to return the offset into the text corresponding to the specified mouse location. `doGetOffset` also sets the graphics port to the port associated with the window under the cursor.

If the part code returned by `FindWindow` indicates that the cursor is within the content region of a window, that window’s graphics port is set as the current port and the cursor location is converted to local coordinates preparatory to the call to `PtInRect`.

If the cursor is within the view rectangle of the `TextEdit` structure associated with the window, `TEGetOffset` is called to get the offset into the text corresponding to the cursor location and `TEGetPoint` is called to get the local coordinates of the character immediately before the offset.

If the offset is at a `TextEdit` line start, and the character immediately before the offset is not a carriage return, and the horizontal coordinate of the character immediately before the offset is less than the horizontal coordinate of the cursor, `theOffset` is decremented by one. In the situation where the cursor is dragged to the right of the rightmost character of a line, this will cause the caret to continue to be drawn immediately to the right of that character instead of “jumping” to the beginning of the next line.

### **isOffsetAtLineStart**

`isOffsetAtLineStart` is called by `doGetOffset`. It returns true if the specified offset is at a `TextEdit` line start.

### **doDrawCaret**

`doDrawCaret` is called by `dragTrackingHandler` to draw and erase the caret. The transfer mode is set to `patXor` so that two successive calls will, in effect, draw and erase the image.

The call to `TEGetPoint` gets the coordinates of the bottom left of the character at the specified offset. The call to the function `doGetLine` returns the `TextEdit` line number that contains the specified offset.

The next block accommodates a quirk of `TextEdit`. For some reason, `TextEdit` does not return the proper coordinates of the last offset in the field if the last character in the record is a carriage return. `TEGetPoint` returns a point that is one line higher than expected. This block fixes the problem.

Following the call to `PenMode`, `TEGetHeight` is called to get the height of a single line of text. A line is then drawn from a point one pixel to the left and above the bottom left of the character at the offset to a point vertically above the starting point. The length of the line is one pixel less than the line height.

### **doGetLine**

`doGetLine` is called by `doDrawCaret`. It returns the `TextEdit` line number that contains the specified offset.

## **ReceiveAndUndoDrag.c**

### **dragReceiveHandler**

`dragReceiveHandler` is the drag receive handler. It is a callback function.

Recall that `dragTrackingHandler` sets `gCanAcceptItems` to true if all items in the drag contained data of the ‘TEXT’ flavor. Recall also that `dragTrackingHandler` sets `gInsertPosition` to -1 if the cursor is over the selection. Thus, if at least one item does not contain data of the ‘TEXT’ flavor, or if the cursor is over the selection at the time the mouse button is released,

the function exits and `dragNotAcceptedErr` is returned to the Drag Manager. `dragNotAcceptedErr` causes the Drag Manager to execute a “zoomback” animation of the drag region to the source location.

The pointer received in the `handlerRefCon` formal parameter is cast to a pointer to the window’s document structure. The handle to the `TextEdit` structure associated with the window is then retrieved from the document structure.

`SetPortWindowPort` sets the window’s graphics port as the current port. The next line saves whether the `TextEdit` structure is currently active or inactive so that the state can later be restored. If the `TextEdit` structure is currently not active, it is made active.

`GetDragAttributes` and `GetDragModifiers` are called to get the drag’s attributes and the modifier keys that were pressed at mouse-down and mouse-up time.

If there are multiple items in the drag, the initial insertion point, which is set in the drag tracking handler, is saved to a local variable for later use by `TESetSelect`. (If there are multiple items to insert, the offset in `gInsertPosition` will be updated each time the main if block executes.)

`CountDragItems` returns the number of items in the drag and the main for loop executes for each item. Within the loop, the first call (to `GetDragItemReferenceNumber`) retrieves the item’s item reference number, which is passed in the call to `GetFlavorDataSize` to get the size of the “TEXT” data. If `GetFlavorDataSize` does not return an error, the following occurs:

- The data size returned by `GetFlavorDataSize` is added to the current size of the text in the `TextEdit` structure. If adding the “TEXT” data to the current text would exceed the `TextEdit` limit, the handler exits, returning `dragNotAcceptedErr` to the Drag Manager.
- A nonrelocatable block the size of the “TEXT” data is created and `GetFlavorData` is called to get the “TEXT” data into that block.
- If the insertion point caret is on the screen, it is removed. (Recall that the global variables used here are set in the drag tracking handler.) If the window is currently highlighted, the highlighting is removed.
- If the drop is within the sender window, the function `doSavePreInsertionText` is called to save the current `TextEdit` text and the current selection start and end. This is to support drag undo/redo. If `doSavePreInsertionText` returns true, flags are set to cause the Undo/Redo item in the Edit menu to be enabled and to cause the initial item text to be set to Undo.
- If there are multiple items in the drag, the initial insertion point is saved for later use by `TESetSelect`. If there are multiple items to insert, the offset in `gInsertPosition` will be updated each time around.

- The variable `moveText` is assigned true if the drop is inside the sender window and the option key was not down when the mouse button was pressed or released. If `moveText` is true, the current selection must be deleted, so the if block executes.
  - Firstly, the current selection start and end are saved to two local variables.
  - The next block implements “smart drag and drop.” If the character just before selection start is a space or CR character, and if the first character in the selection is not such a character, and if the last character in the selection is not such a character, and if the character just after the selection is such a character, then, if the character just after the selection is a space character, the current end of the selection is extended to include that space character. This means that if, for example, just the characters of a word are currently selected, the space character immediately after the selection is added to the selection so that only one space character will remain between the words which bracket the selection when the selection is deleted by `TEDelete`.
  - If the current drop insertion offset is after the selection start offset, the local variable holding the selection end offset is updated (it may have been increased by the “smart drag and drop” code), and `gInsertPosition` and `totalTextStart` offsets are moved back by the length of the selection.
  - `TEDelete` then deletes the selected text (perhaps extended by one by the “smart drag and drop” code) from the `TextEdit` structure and redraws the text.
- The `doInsertTextAtOffset` function is called to insert the ‘TEXT’ data at the current insertion point. This function implements another aspect of “smart drag and drop,” which can possibly add additional characters to the `TextEdit` structure. The number of additional characters added (if any) is returned by the function.
- If the main if block executes again (meaning that there are multiple items in the drag), `gInsertPosition` must be updated to the offset for the next insertion. This is achieved by adding the size of the last insertion, plus the number of any additional characters added by `doInsertTextAtOffset` to the current value in `gInsertPosition`. The value in `totalTextSize` is increased by the same amount.

When all items have been inserted, the main if block exits. `TESetSelect` is then called to set the selection range to the total inserted text. This call unhighlights the previous selection and highlights the new selection range. `doAdjustScrollbar` is called to adjust the scroll bars.

The `windowTouched` field in the document structure is set to true to record the fact that the contents of the window have been modified. The post-insertion selection start and selection end offsets are saved to the relevant fields of the document structure for possible use in the application’s Undo/Redo function.



Finally, if the `TextEdit` structure was not active when `dragReceiveHandler` was entered, it is restored to that state.

### **isWhiteSpaceAtOffset**

`isWhiteSpaceAtOffset` is called by `dragReceiveHandler` and `doInsertTextAtOffset`. Given an offset into a `TextEdit` structure, it determines if the character at that offset is a white space character, that is, a space character or a carriage return character.

### **isWhiteSpace**

`isWhiteSpace` is called by `isWhiteSpaceAtOffset` and `doInsertTextAtOffset`. Given a character, it returns true if that character is either a space character or a carriage return character.

### **doGetCharAtOffset**

`doGetCharAtOffset` is called by `dragReceiveHandler`. Given an offset and a handle to a `TextEdit` structure, it returns the character at that offset.

### **doInsertTextAtOffset**

`doInsertTextAtOffset` is called by `dragReceiveHandler` to insert the drag text at the specified offset. In addition to inserting the text, `dragReceiveHandler` implements additional aspects of “smart drag and drop,” returning the number of space characters, if any, added to the `TextEdit` structure text by this process.

If there is no text in the buffer, the function simply returns.

If the character to the left of the insertion offset is not a space, and if the character at the offset is a space, the insertion is at the end of a word. If, in addition, the first character in the drag is not a space, `TESetSelect` is called to collapse the selection range to an insertion point at the received offset, `TEKey` is called to insert a space character in the `TextEdit` structure at that offset, the offset is incremented by one to accommodate that added character, and the variable that keeps track of the number of added characters is incremented.

The next block is similar, except that it inserts a space character if the insertion is at the beginning of a word and the text to be inserted does not end with a space character. Also, in this block, the offset is not incremented.

With the “smart drag and drop” segment completed, `TESetSelect` is called to ensure that the selection range is collapsed to an insertion point at the (possibly incremented) offset, and `TEInsert` is called to insert the text into the `TextEdit` structure at that insertion point.

### **doSavePreInsertionText**

`doSavePreInsertionText` is called by `dragReceiveHandler` to save the document’s pre-drop text and selection in support of drag and drop undo/redo.



If the `preDragText` field of the window's document structure currently contains `NULL`, a new empty relocatable block is created and its handle assigned to the `preDragText` field.

The next block copies the handle to the `TextEdit` structure's text to a local variable, gets the size of the `TextEdit` structure's text, and expands the newly created block to that size.

`BlockMove` is then called to copy the `TextEdit` structure's text to the newly created block. In addition, the current (pre-drop) selection start and end are saved to the window's document structure.

### **doUndoRedoDrag**

`doUndoRedoDrag` is called by `doEditMenu` in the event of the user choosing the Drag and Drop Undo/Redo item in the Edit menu. That item will only be enabled when the user has released the mouse button and the drop is within the sender window.

The first block means that, each time this function is called, the text block whose handle is assigned to the `TextEdit` structure will toggle between the pre-drop text and the post-drop text. The first time this function is called, the item text in the Edit Menu will be "Drag and Drop Undo" and the `TextEdit` structure will be assigned the handle to pre-drop text saved in the document structure's `preDragText` field. The next time the function is called, the item text in the Edit menu will be "Drag and Drop Redo" and the `TextEdit` structure will be assigned the handle to post-drop text, and so on.

The global variable `gUndoFlag` is toggled by this function. At the next block, and depending on the value in `gUndoFlag`, either the pre-drop or post-drop selection start and end offsets are assigned to the `TextEdit` structure, as appropriate. (`gUndoFlag` also controls the text in the Drag and Drop Undo/Redo item in the Edit menu. See `doAdjustMenus`.)

With the appropriate text and selection assigned to the window's `TextEdit` structure, `TECalcText` is called to wrap the text to the width of the view rectangle and re-calculate the line-starts. Finally, `InvalWindowRect` is called to force a call to `TEUpdate` (in the `doDrawContent` function) to redraw the text.

# Basic Sound and Speech

## CHAPTER

# 24

## IN THIS CHAPTER

- Introduction to Sound 1368
- Sound Production 1371
- Sound Recording—Mac OS 8/9 1374
- Speech 1375
- Relevant Constants, Data Types, and Functions 1376
- The AsynchSoundLib Library 1377
- Demonstration Program SoundAndSpeech Listing 1381
- Demonstration Program SoundAndSpeech Comments 1391

## Introduction to Sound

On the Macintosh, the hardware and software aspects of producing and recording sounds are tightly integrated.

### Audio Hardware and Sound-Related System Software

The audio hardware includes a speaker or speakers, a microphone, and one or more integrated circuits that convert digital data to analog signals and vice versa.

The sound-related system software managers are as follows:

- **The Sound Manager.** The Sound Manager provides the ability to
  - Play sounds through the speakers.
  - Manipulate sounds, that is, vary such characteristics as loudness, pitch, timbre, and duration.
  - Compress sounds so that they occupy less disk space.
- **The Sound Input Manager.** The Sound Input Manager provides the ability to record sounds using a microphone or other sound input device.
- **The Speech Manager.** The Speech Manager provides the ability to convert text into spoken words.

### Sound Input and Output Capabilities

The basic audio hardware, together with the sound-related system software, provides for the following capabilities:

- The playing back of digitally recorded sounds. (Digitally recorded sound is referred to as **sampled** sound.
- The playing back of simple sequences of notes or of complex waveforms.
- The recording of sampled sounds.
- The conversion of text to spoken words.
- The mixing and synchronization of multiple channels of sampled sounds.
- The compression and decompression of sound data.
- The integration and synchronization of sound production with the display of video and still images. (For example, the Sound Manager is used by QuickTime to handle all the sound data in a QuickTime movie.)

## Basic and Enhanced Sound Capabilities

Users can enhance sound playback and recording quality by substituting better speakers and microphones. Audio capabilities may be further enhanced by adding an expansion card containing very high quality digital signal processing (DSP) circuitry, together with sound input or output hardware. Another enhancement option is to add a MIDI interface to one of the serial ports. Fig 1 illustrates the basic sound capabilities of the Macintosh and how those capabilities may be further enhanced and extended.

## Sound Data

The Sound Manager can play sounds defined using one of the following kinds of sound data:

- **Square Wave Data.** Square-wave data can be used to play a simple sequence of sounds in which each sound is described by frequency (pitch), amplitude (volume), duration.
- **Wave-Table Data.** Wave table data may be used to produce more complex sounds than are possible using square-wave data. A wave cycle is represented as an array of bytes that describe the timbre (tone) of a sound at a point in the cycle.
- **Sampled-Sound Data.** Sampled sound data is a continuous list of relative voltages over time that allow the Sound Manager to reconstruct an arbitrary analog wave form. They are typically used to play back prerecorded sounds such as speech or special sound effects.

This chapter is oriented primarily towards the recording and playback of sampled sounds.

## Sampled Sound

Two basic characteristics affect the quality of sampled sound. Those characteristics are sample rate and sample size.

### Sample Rate

Sample rate, or the rate at which voltage samples are taken, determines the highest possible frequency that can be recorded. Specifically, for a given sample rate, sounds can be sampled up to half that frequency. For example, if the sample rate is 22,254 samples per second (that is, 22,254 hertz, or Hz), the highest frequency that can be recorded is about 11,000 Hz. A commercial compact disc is sampled at 44,100 Hz, providing a frequency response of up to about 20,000 Hz, which is the limit of human hearing.

### Sample Size

Sample size, or quantisation, determines the dynamic range of the recording (the difference between the quietest and the loudest sound). If the sample size is eight bits, 256 discrete voltage levels can be recorded. This provides approximately 48 decibels (dB) of dynamic range.

A compact disc's sample size is 16 bits, which provides about 96 dB of dynamic range. (Humans with good hearing are sensitive to ranges greater than 100 dB.)

## Sound Manager Capabilities

The Sound Manager supports 16-bit stereo audio samples with sample rates up to 64kHz.

## Storing Sampled Sounds

Sampled-sound data comprises a series of sample frames. You can use the Sound Manager to store sampled sounds in one of two ways, either in sound resources or in sound files.

## Sound Components

The Sound Manager uses **sound components** to modify sound data. A sound component is a stand-alone code resource that can perform operations on sound data such as compression, decompression, and converting sample rates. Sound components may be hooked together in series to perform complex tasks, as shown in the example in Fig 2.

The Sound Manager is aware of the sound output device selected by the user and assembles a component chain suitable for producing the desired quality of sound on that device. Thus your application is generally unaware of the sound component chain assembled to produce a sound on the selected output device.

## Compression/Decompression Components

Components that compress and decompress sound are called **codecs** (compression/decompression components). Apple Computer supplies codecs that can handle 3:1 and 6:1 compression and expansion, which are suitable for most audio requirements. The Sound Manager can use any available codec to handle compression and expansion of audio data.

### NOTE

A term closely associated with the subject of codecs is **MACE (Macintosh Audio Compression and Expansion)**. MACE is a collection of Sound Manager functions that provide audio data compression and expansion capabilities in ratios of either 3:1 or 6:1. The Sound Manager uses codecs to handle the MACE capabilities.

## Sound Resources

A sound resource is a resource of type 'snd ' that contains sound commands and possibly also sound data. Sound resources provide a simple way for you to incorporate sounds into your application.

# Sound Production

## Sound Channels

A Macintosh produces sound when the Sound Manager sends data through a sound channel to the audio hardware. A sound channel is basically a queue of sound commands (see the following), which might be placed into the sound channel by your application or by the Sound Manager itself.

The Sound Manager uses the `SndChannel` data type to define a sound channel:

```
struct SndChannel
{
    SndChannelPtr  nextChan;      // Pointer to next channel.
    Ptr           firstMod;      // (Used internally.)
    SndCallbackUPP callBack;     // Pointer to callback function.
    long          userInfo;      // Free for application's use.
    long          wait;          // (Used internally.)
    SndCommand    cmdInProgress; // (Used internally.)
    short         flags;         // (Used internally.)
    short         qLength;       // (Used internally.)
    short         qHead;         // (Used internally.)
    short         qTail;         // (Used internally.)
    SndCommand    queue[128];    // (Used internally.)
}
typedef struct SndChannel SndChannel;
typedef SndChannel *SndChannelPtr;
```

## Multiple Sound Channels

It is possible to have several channels of sound open at one time. The Sound Manager (using the Apple Mixer sound component) mixes together the data coming from all open sound channels and sends a single stream of sound data to the current sound output device. This allows a single application to play two or more sounds at once. It also allows multiple applications to play sounds at the same time.

## Sound Commands

When you call the appropriate Sound Manager function to play a sound, the Sound Manager issues one or more sound commands to the audio hardware. A sound command is an instruction to produce or modify sound, or otherwise contribute to the overall sound production process. The structure of a sound command is defined by the `SndCommand` data type:

```
struct SndCommand
{
    unsigned short cmd;    // Command number.
    short         param1;  // First parameter.
    long          param2;  // Second parameter.
};
typedef struct SndCommand SndCommand;
```



The Sound Manager provides a rich set of sound commands, which are defined by constants. Some examples are as follows:

```
quietCmd  = 3   Stop the sound currently playing.
flushCmd  = 4   Remove all commands currently queued in specified sound channel.
syncCmd   = 14  Synchronise multiple channels of sound.
soundCmd  = 80  Install a sampled sound as a voice in a channel.
bufferCmd = 81  Play a buffer of sampled-sound data.
```

## NOTE

Several Sound Manager sound commands are not available in Carbon.

## Sound Commands In 'snd' Resources

A simple way to issue sound commands is to call the function `SndPlay`, specifying a sound resource of type 'snd' that contains the sound commands you want to issue.

Often, a 'snd' resource consists only of a single sound command (usually the `bufferCmd` command) together with data that describes a sampled sound to be played. The following is an example of such a 'snd' resource, shown in the form of the output of the MPW tool `DeRez` when applied to the resource:

```
data 'snd' (19068,"My sound",purgeable)
{
    /* Sound resource header */
    "$0001" /* Format type. */
    "$0001" /* Number of data types. */
    "$0005" /* Sampled-sound data. */
    "$00000080" /* Initialisation option: initMono. */
    /* Sound commands */
    "$0001" /* Number of sound commands that follow (1). */
    "$8051" /* Command 1 (bufferCmd). */
    "$0000" /* param1 = 0. */
    "$00000014" /* param2 = offset to sound header (20 bytes). */
    /* Sampled sound header (Standard sound header)*/
    "$00000000" /* samplePtr Pointer to data (it follows immediately). */
    "$00000BB8" /* length Number of bytes in sample (3000 bytes). */
    "$56EE8BA3" /* sampleRate Sampling rate of this sound (22 kHz). */
    "$000007D0" /* loopStart Starting of the sample's loop point. */
    "$00000898" /* loopEnd Ending of the sample's loop point. */
    "$00" /* encode Standard sample encoding. */
    "$3C" /* baseFrequency BaseFrequency at which sample was taken. */
    /* sampleArea[] Sampled sound data */
    "$80 80 81 81 81 81 81 81 80 80 80 80 80 81 82 82"
    "$82 83 82 82 81 80 80 7F 7F 7F 7E 7D 7D 7D 7C 7C"
    (Rest of sampled sound data.)
};
```

Note that the sound resource header section indicates that the sound is defined using sampled-sound data. Note also that the sound commands section contains a call to a single sound command (the `bufferCmd` command (`0x51`)) and that the offset bit of the command number is set to indicate that the sound data is contained within the resource itself. (Data can also be stored in a buffer separate from a sound resource.) The second parameter to the `bufferCmd` command indicates the offset from the beginning of the resource to the sampled sound header, which immediately follows the sound commands section.

#### NOTE

The sampled sound header shown is a standard sound header, which can reference only buffers of monophonic 8-bit sound. The extended sound header is used for 8-bit or 16-bit stereo sound data as well as monophonic sound data. The compressed sound header is used to describe compressed sound data, whether monophonic or stereo.

Note that the first part of the sampled sound header contains information about the sample and that the sampled sound data is part of the sampled sound header.

## Sending Sound Commands Directly from the Application

You can also send sound commands into a sound channel one at a time by calling `SndDoCommand` or you can bypass a sound queue altogether by calling the `SndDoImmediate`.

## Synchronous and Asynchronous Sound

You can play sounds either synchronously or asynchronously. When your application plays a sound synchronously, it cannot continue executing until the sound has finished playing. When your application plays a sound asynchronously, it can continue other processing while the sound is playing.

From a programming standpoint, asynchronous sound production is considerably more complex than synchronous sound production.

## Playing a Sound

#### NOTE

The Sound Manager function `SndStartFilePlay` (starts a file playing from disk), together with the associated functions `SndPauseFilePlay`, `SndStopFilePlay`, `SndPlayDoubleBuffer`, are not available in Carbon.



## Playing a Sound Resource

You can load a sound resource into memory and then play it using the `SndPlay` function. As previously stated, a 'snd' resource contains sound commands that play the desired sound and might also contain sound data. If the sound data is compressed, `SndPlay` decompresses the data in order to play the sound.

### Channel Allocation

If you pass `NULL` in the first parameter of `SndPlay`, a sound channel will be automatically allocated to play the sound and then automatically disposed of when the sound has finished playing.

## Playing Sounds Asynchronously

The Sound Manager allows you to play sounds asynchronously only if you allocate sound channels yourself. If you use such a technique, your application will need to dispose of a sound channel whenever the application finishes playing a sound. In addition, your application might need to release a sound resource that you played on a sound channel.

The Sound Manager provides certain mechanisms that allow your application to ascertain when a sound finishes playing, so that it can arrange to dispose of a sound channel no longer being used and other data (such as a sound resource) that you no longer need after disposing of the channel. Despite the existence of these mechanisms, the programming aspects of asynchronous sound remain rather complex. For that reason, the demonstration program files associated with this chapter include a library, called `AsynchSoundLib`, which support asynchronous sound playback and which eliminates the necessity for your application to itself include source code relating to the more complex aspects of asynchronous sound management.

`AsynchSoundLib`, which may be used by any application that requires a straightforward and uncomplicated interface for asynchronous sound playback, is documented following the Constants, Data Types, and Functions section of this chapter.

## Sound Recording—Mac OS 8/9

On Mac OS 8/9, the Sound Input Manager provides a high-level function that allows your application to record sounds from the user and store them in memory. When you call this function, the Sound Input Manager presents the sound recording dialog shown in Fig 3.

### NOTE

The Sound Manager function `SndRecordToFile` (records sound data to a file) is not available in Carbon.

## Recording a Sound Resource

You can record sounds from the current input device using the `SndRecord` function. When calling `SndRecord`, you can pass a handle to a block of memory in the fourth parameter. The incoming data will then be stored in that block, the size of which determines the recording time available. If you pass `NULL` in the fourth parameter, the Sound Input Manager allocates the largest possible block in the application heap. Either way, the Sound Input Manager resizes the block when the user clicks the Save button.

When you have recorded a sound, you can play it back by calling `SndPlay` and passing it the handle to the block of memory in which the sound data is stored. That block has the structure of a 'snd' resource, but its handle is not a handle to an existing resource. To save the recorded data as a resource, you can use the appropriate Resource Manager functions in the usual way.

## Recording Quality

One of the following constants should be passed in the third parameter of the `SndRecord` call so as to specify the recording quality required:

<i>Constant</i>	<i>Value</i>	<i>Meaning</i>
<code>siCDQuality</code>	'cd'	44.1kHz, stereo, 16 bit.
<code>siBestQuality</code>	'best'	22kHz, mono, 8 bit.
<code>siBetterQuality</code>	'betr'	22kHz, mono, 3:1 compression.
<code>siGoodQuality</code>	'good'	22KHz, mono, 6:1 compression

The highest quality sound naturally requires the greatest storage space. Accordingly, be aware that, for most voice recording, you should specify `siGoodQuality`.

As an example of the storage space required for sounds, one minute of monophonic sound recorded with the same fidelity as a commercial compact disc occupies about 5.3 MB of disk space, and one minute of telephone-quality speech takes up more than half a megabyte.

## Speech

The Speech Manager converts text into sound data and passes to the Sound Manager. The Speech Manager utilises a speech synthesizer, which can include one or more voices, each of which may have different tonal qualities.

## Generating Speech From a String

The `SpeakString` function is used to convert a text string into speech. `SpeakString` automatically allocates a speech channel, produces the speech on that channel, and then disposes of the speech channel.

### Asynchronous Speech

Speech generation is asynchronous, that is, control returns to your application before `SpeakString` finishes speaking the string. However, you are free to release the memory allocated for the string as soon as `SpeakString` returns, the reason being that `SpeakString` copies the string into an internal buffer.

### Synchronous Speech

If you wish to generate speech synchronously, you can use `SpeakString` in conjunction with the `SpeechBusy` function, which returns the number of active speech channels, including the speech channel created by the `SpeakString` function.

## Relevant Constants, Data Types, and Functions

### Constants

#### Recording Qualities

```
siCDQuality    = FOUR_CHAR_CODE('cd ')  44.1kHz, stereo, 16 bit.
siBestQuality   = FOUR_CHAR_CODE('best') 22kHz, mono, 8 bit.
siBetterQuality = FOUR_CHAR_CODE('betr') 22kHz, mono, MACE 3:1.
siGoodQuality   = FOUR_CHAR_CODE('good') 22kHz, mono, MACE 6:1.
```

#### Typical Sound Commands

```
quietCmd       = 3   Stop the sound currently playing.
flushCmd       = 4   Remove all commands currently queued in specified sound channel.
syncCmd        = 14  Synchronise multiple channels of sound.
soundCmd       = 80  Install a sampled sound as a voice in a channel.
bufferCmd      = 81  Play a buffer of sampled-sound data.
```

### Data Types

#### Sound Channel Structure

```
struct SndChannel
{
    SndChannelPtr nextChan;    // Pointer to next channel.
    Ptr           firstMod;    // (Used internally.)
    SndCallBackUPP callBack;  // Pointer to callback function.
    long          userInfo;    // Free for application's use.
    long          wait;        // (Used internally.)
    SndCommand    cmdInProgress; // (Used internally.)
    short         flags;      // (Used internally.)
}
```

```

short      qLength;          // (Used internally.)
short      qHead;            // (Used internally.)
short      qTail;            // (Used internally.)
SndCommand queue[128];       // (Used internally.)
}
typedef struct SndChannel SndChannel;
typedef SndChannel *SndChannelPtr;

```

## Sound Command Structure

```

struct SndCommand
{
    unsigned short cmd;        // Command number.
    short          param1;     // First parameter.
    long           param2;     // Second parameter.
};
typedef struct SndCommand SndCommand;

```

## Functions

### Playing Sound Resources

```

void SysBeep(short duration);
OSErr SndPlay(SndChannelPtr chan, SndListHandle sndHdl, Boolean async);

```

### Allocating and Releasing Sound Channels

```

OSErr SndNewChannel(SndChannelPtr *chan, short synth, long init, SndCallBackUPP userRoutine);
OSErr SndDisposeChannel(SndChannelPtr chan, Boolean quietNow);

```

### Sending Commands to a Sound Channel

```

OSErr SndDoCommand(SndChannelPtr chan, const SndCommand *cmd, Boolean noWait);
OSErr SndDoImmediate(SndChannelPtr chan, const SndCommand *cmd);

```

### Recording Sounds

```

OSErr SndRecord(ModalFilterUPP filterProc, Point corner, OSType quality,
                SndListHandle *sndHandle);

```

### Generating Speech

```

OSErr SpeakString(ConstStr255Param textToBeSpoken);
short SpeechBusy(void);

```

## The AsynchSoundLib Library

The AsynchSoundLib library is intended to provide a straightforward and uncomplicated interface for asynchronous sound playback.

AsynchSoundLib requires that you include a global “attention” flag in your application. At startup, your application must call AsynchSoundLib’s initialization function and provide the address of this attention flag. Thereafter, the application must continually check the attention flag within its main event loop.

AsynchSoundLib's main function is to spawn asynchronous sound tasks, and communication between your application and AsynchSoundLib is carried out on an as-required basis. The basic phases of communication for a typical sound playback sequence are as follows:

- Your application tells AsynchSoundLib to play some sound.
- AsynchSoundLib uses the Sound Manager to allocate a sound channel and begins asynchronous playback of your sound.
- The application continues executing, with the sound playing asynchronously in the background.
- The sound completes playback. AsynchSoundLib has set up a sound command that causes it (AsynchSoundLib) to be informed immediately upon completion of playback. When playback ceases, AsynchSoundLib sets the application's global attention flag.
- The next time through your application's event loop, the application notices that the attention flag is set and calls AsynchSoundLib to free up the sound channel.

When your application terminates, it must call AsynchSoundLib to stop any asynchronous playback in progress at the time.

AsynchSoundLib's method of communication with the application minimizes processing overhead. By using the attention flag scheme, your application calls AsynchSoundLib's cleanup function only when it is really necessary.

## AsynchSoundLib Functions

The following documents those AsynchSoundLib functions that may be called from an application.

To facilitate an understanding of the following, it is necessary to be aware that AsynchSoundLib associates a data structure, referred to in the following as an ASStructure, with each channel. Each ASStructure includes the following fields:

```
SndChannel  channel;      // The sound channel.
SInt32      refNum;       // Reference number.
Handle      sound;        // The sound.
char        handleState;  // State to which to restore the sound handle.
Boolean     inUse;        // Is this ASStructure currently in use?
```

```
OSErr  AS_Initialise(attnFlag,numChannels);
```

```
Boolean *attnFlag;  Pointer to application's "attention" flag global variable.
SInt16  numChannels; Number of channels required to be open simultaneously. If 0 is
                        specified, numChannels defaults to 4.
```

**Returns:** 0 No errors.  
Non-zero results of MemError call.

This function stores the address of the application's "attention" flag global variable and then allocates memory for a number of ASStructures equal to the requested number of sound channels.

```
OSErr AS_PlayID(resID, refNum);
```

SInt16 resID     Resource ID of the 'snd ' resource.

SInt32 \*refNum   A pointer to a reference number storage variable. Optional.

**Returns:** 0 No errors.

1 No channels available.

Non-zero results of ResError call.

Non-zero results of SndNewChannel call.

Non-zero results of SndPlay call.

This function initiates asynchronous playback of the 'snd' resource with ID resID.

If you pass a pointer to a variable in their refNum parameters, AS\_PlayID and its sister function AS\_PlayHandle (see below) return a reference number in that parameter. As will be seen, this reference number may be used to gain more control over the playback process. However, if you simply want to trigger a sound and let it run to completion, with no further control over the playback process, you can pass NULL in the refNum parameter. In this case, a reference number will not be returned.

First, AS\_PlayID attempts to load the specified 'snd ' resource. If successful, the handle state is saved for later restoration, and the handle is made unpurgeable. The function then gets a reference number and a pointer to the next free ASStructure. A sound channel is then allocated via a call to SndNewChannel and the associated ASStructure is initialised. HLockHi is then called to move the sound handle high in the heap and lock it. SndPlay is then called to start the sound playing, playing, the channel.userInfo field is set to indicate that the sound is playing, and a callback function is queued so that AsyncSoundLib will know when the sound has stopped playing. If all this is successful, AS\_PlayID returns the reference number associated with the channel (if the caller wants it).

```
OSErr AS_PlayHandle(sound, refNum);
```

Handle sound     A handle to the sound to be played.

SInt32 \*refNum   A pointer to a reference number storage variable. Optional.

**Returns:** 0 If no errors.

1 No channels available.

Non-zero results of SndNewChannel call.

Non-zero results of SndPlay call.

This function initiates asynchronous playback of the sound referred to by sound.

The AS\_PlayHandle function is similar to AS\_PlayID, except that it supports a special case: You can pass AS\_PlayHandle a NULL handle. This causes AS\_PlayHandle to open a sound channel but not call SndPlay. Normally, you do this when you want to get a sound channel and then send sound commands directly to that channel yourself. (See AS\_GetChannel, below.)

If a handle is provided, its current state is saved for later restoration before it is made unpurgeable. `AS_PlayHandle` then gets a reference number and a pointer to a free `ASStructure`. A sound channel is then allocated via a call to `SndNewChannel` and the associated `ASStructure` is initialised. Then, if a handle was provided, `HLockHi` is called to move the sound handle high in the heap and lock it, following which `SndPlay` is called to start the sound playing, the `channel.userInfo` field is set to indicate that the sound is playing, and a callback function is queued so that `AsynchSoundLib` will know when the sound has stopped playing. Finally, the reference number associated with the channel is returned (if the caller wants it).

```
OSErr AS_GetChannel(refNum,channel);
```

```
Sint32      refNum    Reference number.
SndChannelPtr *channel A pointer to a SoundChannelPtr.
```

**Returns:** 0 No errors.  
1 If `refNum` does not refer to any current `ASStructure`.

This function searches for the `ASStructure` associated with `refNum`. If one is found, a pointer to the associated sound channel is returned in the `channel` parameter.

`AS_GetChannel` is provided so as to allow an application to gain access to the sound channel associated with a specified reference number and thus gain the potential for more control over the playback process. It allows an application to use `AsynchSoundLib` to handle sound channel management while at the same time retaining the ability to send sound commands to the channel. This is most commonly done to play looped continuous music, for which you will need to provide a sound resource with a loop and a sound command to install the music as a voice. First, you open a channel by calling `AS_PlayHandle`, specifying `NULL` in the first parameter. (This causes `AS_PlayHandle` to open a sound channel but not call `SndPlay`.) Armed with the returned reference number associated with that channel, you then call `AS_GetChannel` to get the `SndChannelPtr`, which you then pass as the first parameter in a call to `SndPlay`. Finally, you send a `freqCmd` command to the channel to start the music playing. The playback will keep looping until you send a `quietCmd` command to the channel.

```
void AS_CloseChannel(void);
```

This function is called from the application's event loop if the application's "attention" flag is set. It clears the "attention" flag and then performs playback cleanup by iterating through the `ASStructures` looking for structures that are both in use (that is, the `inUse` field contains `true`) and complete (that is, the `channel.userInfo` field has been set by `AsynchSoundLib`'s callback function to indicate that the sound has stopped playing). It frees up such structures for later use and closes the associated sound channel.

```
void AS_CloseDown(void);
```

AS\_CloseDown checks that AsynchSoundLib was previously initialized, stops all current playback, calls AS\_CloseChannel to close open sound channels, and disposes of the associated ASStructures.

## Demonstration Program SoundAndSpeech Listing

```
// *****
// SoundAndSpeech.c                                     CARBON EVENT MODEL
// *****
//
// This program opens a modeless dialog containing five bevel button controls arranged in
// two groups, namely, a synchronous sound group and an asynchronous sound group. Clicking on
// the bevel buttons causes sound to be played back or recorded as follows:
//
// • Synchronous group:
//
//   • Play sound resource.
//
//   • Record sound resource (Mac OS 8/9 only).
//
//   • Speak text string.
//
// • Asynchronous group:
//
//   • Play sound resource.
//
//   • Speak text string.
//
// The asynchronous sound sections of the program utilise a special library called
// AsyncSoundLibPPC, which must be included in the CodeWarrior project.
//
// The program utilises the following resources:
//
// • A 'plst' resource.
//
// • A 'DLOG' resource and associated 'DITL', 'dlgx', and 'dftb' resources (all purgeable).
//
// • 'CNTL' resources (purgeable) for the controls within the dialog.
//
// • Two 'snd ' resources, one for synchronous playback (purgeable) and one for asynchronous
//   playback (purgeable).
//
// • Four 'cicn' resources (purgeable). Two are used to provide an animated display which
//   halts during synchronous playback and continues during asynchronous playback. The
//   remaining two are used by the bevel button controls.
//
// • Two 'STR#' resources containing "speak text" strings and error message strings (all
//   purgeable).
//
// • 'hrct' and 'hwin' resources (purgeable) for balloon help.
//
```



```

// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// Each time it is invoked, the function doRecordResource creates a new 'snd' resource with a
// unique ID in the resource fork of a file titled "SoundResources".
//
// *****

// ..... includes

#include <Carbon.h>
#include <string.h>

// ..... defines

#define rDialog          128
#define iDone            1
#define iPlayResourceSync 4
#define iRecordResource  5
#define iSpeakTextSync   6
#define iPlayResourceASync 7
#define iSpeakTextAsync  8
#define rPlaySoundResourceSync 8192
#define rPlaySoundResourceASync 8193
#define rSpeechStrings   128
#define rErrorStrings    129
#define eOpenDialogFail  1
#define eCannotInitialise 2
#define eGetResource     3
#define eMemory          4
#define eMakeFSSpec      5
#define eWriteResource    6
#define eNoChannelsAvailable 7
#define ePlaySound       8
#define eSndPlay         9
#define eSndRecord      10
#define eSpeakString     11
#define rColorIcon1      128
#define rColorIcon2      129
#define kMaxChannels     8
#define kOutOfChannels   1

// ..... global variables

Boolean    gRunningOnX = false;
DialogRef  gDialogRef;
CIconHandle gColorIconHdl1;
CIconHandle gColorIconHdl2;

// ..... AsyncSoundLib attention flag

Boolean    gCallAS_CloseChannel = false;

```

```

// ..... function prototypes

void      main                (void);
void      doPreliminaries     (void);
OSStatus  windowEventHandler  (EventHandlerCallRef,EventRef,void *);
void      doIdle              (void);
void      doInitialiseSoundLib (void);
void      doDialogHit         (SInt16);
void      doPlayResourceSync   (void);
void      doRecordResource     (void);
void      doSpeakStringSync    (void);
void      doPlayResourceASync  (void);
void      doSpeakStringAsync   (void);
void      doSetUpDialog        (void);
void      doErrorAlert         (SInt16);
void      helpTags            (DialogRef);

// ..... AsyncSoundLib function prototypes

OSErr AS_Initialise  (Boolean *,SInt16);
OSErr AS_GetChannel  (SInt32,SndChannelPtr *);
OSErr AS_PlayID      (SInt16, SInt32 *);
OSErr AS_PlayHandle  (Handle,SInt32 *);
void  AS_CloseChannel (void);
void  AS_CloseDown   (void);

// ***** main

void main(void)
{
    SInt32      response;
    EventTypeSpec windowEvents[] = { { kEventClassWindow, kEventWindowClose },
                                      { kEventClassMouse,  kEventMouseDown  } };

    // ..... do preliminaries

    doPreliminaries();

    // ..... disable Quit item in Mac OS X Application menu

    DisableMenuCommand(NULL,'quit');

    // ..... install a timer

    InstallEventLoopTimer(GetCurrentEventLoop(),0,TicksToEventTime(10),
                          NewEventLoopTimerUPP((EventLoopTimerProcPtr) doIdle),NULL,
                          NULL);

    // ..... open and set up dialog

    if(!(gDialogRef = GetNewDialog(rDialog,NULL,(WindowRef) -1)))
    {
        doErrorAlert(eOpenDialogFail);
        ExitToShell();
    }
}

```

```

SetPortDialogPort(gDialogRef);
SetDialogDefaultItem(gDialogRef, kStdOkItemIndex);

ChangeWindowAttributes(GetDialogWindow(gDialogRef), kWindowStandardHandlerAttribute |
                        kWindowCloseBoxAttribute,
                        kWindowCollapseBoxAttribute);

InstallWindowEventHandler(GetDialogWindow(gDialogRef),
                          NewEventHandlerUPP((EventHandlerProcPtr) windowEventHandler),
                          GetEventTypeCount(windowEvents), windowEvents, 0, NULL);

Gestalt(gestaltMenuMgrAttr, &response);
if(response & gestaltMenuMgrAquaLayoutMask)
{
    helpTags(gDialogRef);
    gRunningOnX = true;
}

doSetUpDialog();

// ..... initialise AsyncSoundLib

doInitialiseSoundLib();

// ..... get color icons

gColorIconHdl1 = GetCIcon(rColorIcon1);
gColorIconHdl2 = GetCIcon(rColorIcon2);

// ..... run application event loop

RunApplicationEventLoop();
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(64);
    InitCursor();
    FlushEvents(everyEvent, 0);
}

// ***** windowEventHandler

OSStatus windowEventHandler(EventHandlerCallRef eventHandlerCallRef, EventRef eventRef,
                           void* userData)
{
    OSStatus    result = eventNotHandledErr;
    UInt32      eventClass;
    UInt32      eventKind;
    EventRecord eventRecord;
    SInt16      itemHit;

```

```

eventClass = GetEventClass(eventRef);
eventKind = GetEventKind(eventRef);

switch(eventClass)
{
    case kEventClassWindow: // event class window
        switch(eventKind)
        {
            case kEventWindowClose:
                AS_CloseDown();
                QuitApplicationEventLoop();
                result = noErr;
                break;
        }

    case kEventClassMouse: // event class mouse
        ConvertEventRefToEventRecord(eventRef,&eventRecord);
        switch(eventKind)
        {
            case kEventMouseDown:
                if(IsDialogEvent(&eventRecord))
                {
                    if(DialogSelect(&eventRecord,&gDialogRef,&itemHit))
                        doDialogHit(itemHit);
                    result = noErr;
                }
                break;
        }
        break;
}

return result;
}

// ***** doIdle

void doIdle(void)
{
    Rect        theRect, eraseRect;
    UInt32      finalTicks;
    SInt16      fontNum;
    static Boolean flip;

    SetRect(&theRect,262,169,294,201);
    SetRect(&eraseRect,310,170,481,200);

    if(gCallAS_CloseChannel)
    {
        AS_CloseChannel();

        GetFNum("\pGeneva",&fontNum);
        TextFont(fontNum);
        TextSize(10);
        MoveTo(341,189);

```

```

        DrawString("\pAS_CloseChannel called");
        QDFlushPortBuffer(GetWindowPort(FrontWindow()),NULL);
        Delay(45,&finalTicks);
    }

    if(flip)
        PlotCIcon(&theRect,gColorIconHd1);
    else
        PlotCIcon(&theRect,gColorIconHd12);

    flip = !flip;

    EraseRect(&eraseRect);
}

// ***** doInitialiseSoundLib

void doInitialiseSoundLib(void)
{
    if(AS_Initialise(&gCallAS_CloseChannel,kMaxChannels) != noErr)
    {
        doErrorAlert(eCannotInitialise);
        ExitToShell();
    }
}

// ***** doDialogHit

void doDialogHit(SInt16 item)
{
    switch(item)
    {
        case iDone:
            AS_CloseDown();
            QuitApplicationEventLoop();
            break;

        case iPlayResourceSync:
            doPlayResourceSync();
            break;

        case iRecordResource:
            doRecordResource();
            break;

        case iSpeakTextSync:
            doSpeakStringSync();
            break;

        case iPlayResourceASync:
            doPlayResourceASync();
            break;
    }
}

```

```

        case iSpeakTextAsync:
            doSpeakStringAsync();
            break;
    }
}

// ***** doPlayResourceSync

void doPlayResourceSync(void)
{
    SndListHandle sndListHdl;
    SInt16         resErr;
    OSErr          osErr;
    ControlRef     controlRef;

    sndListHdl = (SndListHandle) GetResource('snd ', rPlaySoundResourceSync);
    resErr = ResError();
    if(resErr != noErr)
        doErrorAlert(eGetResource);

    if(sndListHdl != NULL)
    {
        HLock((Handle) sndListHdl);
        osErr = SndPlay(NULL, sndListHdl, false);
        if(osErr != noErr)
            doErrorAlert(eSndPlay);
        HUnlock((Handle) sndListHdl);
        ReleaseResource((Handle) sndListHdl);

        GetDialogItemAsControl(gDialogRef, iPlayResourceSync, &controlRef);
        SetControlValue(controlRef, 0);
    }
}

// ***** doRecordResource

void doRecordResource(void)
{
    SInt16         oldResFileRefNum, theResourceID, resErr, tempResFileRefNum;
    BitMap         screenBits;
    Point          topLeft;
    OSErr          memErr, osErr;
    Handle          soundHdl;
    FSSpec         fileSpecTemp;
    ControlRef     controlRef;

    oldResFileRefNum = CurResFile();

    GetQDGlobalsScreenBits(&screenBits);
    topLeft.h = (screenBits.bounds.right / 2) - 156;
    topLeft.v = 150;

    soundHdl = NewHandle(25000);
    memErr = MemError();

```

```

if(memErr != noErr)
{
    doErrorAlert(eMemory);
    return;
}

osErr = FSMakeFSSpec(0,0,"\\pSoundResources",&fileSpecTemp);
if(osErr == noErr)
{
    tempResFileRefNum = FSpOpenResFile(&fileSpecTemp,fsWrPerm);
    UseResFile(tempResFileRefNum);
}
else
    doErrorAlert(eMakeFSSpec);

if(osErr == noErr)
{
    osErr = SndRecord(NULL,topLeft,siBetterQuality,&(SndListHandle) soundHdl);
    if(osErr != noErr && osErr != userCanceledErr)
        doErrorAlert(eSndRecord);
    else if(osErr != userCanceledErr)
    {
        do
        {
            theResourceID = UniqueID('snd ');
        } while(theResourceID <= 8191 && theResourceID >= 0);

        AddResource(soundHdl,'snd ',theResourceID,"\\pTest");
        resErr = ResError();
        if(resErr == noErr)
            UpdateResFile(tempResFileRefNum);
        resErr = ResError();
        if(resErr != noErr)
            doErrorAlert(eWriteResource);
    }

    CloseResFile(tempResFileRefNum);
}

DisposeHandle(soundHdl);
UseResFile(oldResFileRefNum);

GetDialogItemAsControl(gDialogRef,iRecordResource,&controlRef);
SetControlValue(controlRef,0);
}

// ***** doSpeakStringSync

void doSpeakStringSync(void)
{
    SInt16    activeChannels;
    Str255    theString;
    OSError   resErr, osErr;
    ControlRef controlRef;

```

```

activeChannels = SpeechBusy();

GetIndString(theString,rSpeechStrings,1);
resErr = ResError();
if(resErr != noErr)
{
    doErrorAlert(eGetResource);
    return;
}

osErr = SpeakString(theString);
if(osErr != noErr)
    doErrorAlert(eSpeakString);

while(SpeechBusy() != activeChannels)
    ;

GetDialogItemAsControl(gDialogRef,iSpeakTextSync,&controlRef);
SetControlValue(controlRef,0);
}

// ***** doPlayResourceASync

void doPlayResourceASync(void)
{
    SInt16 error;

    error = AS_PlayID(rPlaySoundResourceASync,NULL);
    if(error == kOutOfChannels)
        doErrorAlert(eNoChannelsAvailable);
    else
        if(error != noErr)
            doErrorAlert(ePlaySound);
}

// ***** doSpeakStringASync

void doSpeakStringASync(void)
{
    Str255 theString;
    OSerr resErr, osErr;

    GetIndString(theString,rSpeechStrings,2);
    resErr = ResError();
    if(resErr != noErr)
    {
        doErrorAlert(eGetResource);
        return;
    }

    osErr = SpeakString(theString);
    if(osErr != noErr)
        doErrorAlert(eSpeakString);
}

```



```
// ***** doSetUpDialog

void doSetUpDialog(void)
{
    SInt16          a;
    Point           offset;
    ControlRef       controlRef;
    ControlButtonGraphicAlignment alignConstant = kControlBevelButtonAlignLeft;
    ControlButtonTextPlacement    placeConstant = kControlBevelButtonPlaceToRightOfGraphic;

    offset.v = 1;
    offset.h = 5;

    for(a=iPlayResourceSync;a<iSpeakTextAsync+1;a++)
    {
        GetDialogItemAsControl(gDialogRef,a,&controlRef);
        SetControlData(controlRef,kControlEntireControl,kControlBevelButtonGraphicAlignTag,
            sizeof(alignConstant),&alignConstant);
        SetControlData(controlRef,kControlEntireControl,kControlBevelButtonGraphicOffsetTag,
            sizeof(offset),&offset);
        SetControlData(controlRef,kControlEntireControl,kControlBevelButtonTextPlaceTag,
            sizeof(placeConstant),&placeConstant);
    }

    if(gRunningOnX)
    {
        GetDialogItemAsControl(gDialogRef,iRecordResource,&controlRef);
        DeactivateControl(controlRef);
    }
}

// ***** doErrorAlert

void doErrorAlert(SInt16 errorStringIndex)
{
    Str255 errorString;
    SInt16 itemHit;

    GetIndString(errorString,rErrorStrings,errorStringIndex);
    StandardAlert(kAlertCautionAlert,errorString,NULL,NULL,&itemHit);
}

// ***** helpTags

void helpTags(DialogRef dialogRef)
{
    HMHelpContentRec helpContent;
    SInt16          a;
    ControlRef       controlRef;

    memset(&helpContent,0,sizeof(helpContent));
    HMSetTagDelay(500);
    HMSetHelpTagsDisplayed(true);
}
```

```

helpContent.version = kMacHelpVersion;
helpContent.tagSide = kHMOOutsideTopCenterAligned;
helpContent.content[kHMMMinimumContentIndex].contentType = kHMStringResContent;
helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmResID = 130;

for(a = 1; a <= 5; a++)
{
    if(a == 2)
        continue;
    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = a;
    GetDialogItemAsControl(dialogRef, a + 3, &controlRef);
    HMSSetControlHelpContent(controlRef, &helpContent);
}
}

// *****

```

## Demonstration Program SoundAndSpeech Comments

When this program is run, the user should click on the various buttons in the dialog to play back and record (Mac OS 8/9 only) sound resources and to play back the provided “speak text” strings. The user should observe the effects of asynchronous and synchronous playback on the “working man” icon in the image well in the dialog. The user should also observe that the text “AS\_CloseChannel called” appears briefly in the secondary group box to the right of the “working man” icon when AsynchSoundLib sets the application’s “attention” flag to true, thus causing the application to call the AsynchSoundLib function AS\_CloseChannel.

Note that the doRecordResource function saves recorded sounds as ‘snd’ resources with unique IDs in the resource fork of the file titled “SoundResources.”

On Mac OS 9, ensure that the Speech Manager extension is activated before running this program.

### Defines

kMaxChannels will be used to specify the maximum number of sound channels that AsynchSoundLib is to open. kOutOfChannels will be used to determine whether the AsynchSoundLib function AS\_PlayID returns a “no channels available” error.

### Main

A timer is installed and set to fire repeatedly every 10 ticks. When the timer fires, the function doIdle is called.

doInitialiseSoundLib is called to initialise the AsynchSoundLib library.

**doIdle**

doIdle is called every time the timer fires.

The “attention” flag (gAS\_CloseChannel) required by AsynchSoundLib is checked. If AsynchSoundLib has set it to true, the AsynchSoundLib function AS\_CloseChannel is called to free up the relevant ASStructure, close the relevant sound channel, and clear the “attention” flag. In addition, some text is drawn in the group box to the right of the “working man” icon to indicate to the user that AS\_CloseChannel has just been called.

The next block draws one or other of the two “working man” icons, following which the interior of the group box is erased.

**doInitialiseSoundLib**

doInitialiseSoundLib initializes the AsynchSoundLib library. More specifically, it calls the AsynchSoundLib function AS\_Initialise and passes to AsynchSoundLib the address of the application’s “attention” flag (gAS\_CloseChannel), together with the requested number of channels.

If AS\_Initialise returns a non-zero value, an error alert is displayed and the program terminates.

**doPlayResourceSync**

doPlayResourceSync is the first of the synchronous playback functions. It uses SndPlay to play a specified 'snd' resource.

GetResource attempts to load the resource. If the subsequent call to ResError indicates an error, an error alert is presented.

If the load was successful, the sound handle is locked prior to a call to SndPlay. Since NULL is passed in the first parameter of the SndPlay call, SndPlay automatically allocates a sound channel to play the sound and deallocates the channel when the playback is complete. false passed in the third parameter specifies that the playback is to be synchronous.

**NOTE**

The 39940-byte 'snd' resource being used contains one command only (bufferCmd). The compressed sound header indicates MACE 3:1 compression. The sound length is 119568 frames. The 8-bit mono sound was sampled at 22kHz.

SndPlay causes all commands and data contained in the sound handle to be sent to the channel. Since there is a bufferCmd command in the 'snd' resource, the sound is played.

If `SndPlay` returns an error, an error alert is presented.

When `SndPlay` returns, `HUnlock` unlocks the sound handle and `ReleaseResource` releases the resource.

### **doRecordResource**

On Mac OS 8/9 only, `doRecordResource` uses `SndRecord` to record a sound synchronously and then saves the sound in a 'snd ' resource. The 'snd ' resource will be saved to the resource fork of the file "SoundResources."

The first line saves the file reference number of the current resource file. The next three lines establish the location for the top left corner of the sound recording dialog.

`NewHandle` creates a relocatable block. The address of the handle will be passed as the fourth parameter of the `SndRecord` call. The size of this block determines the recording time available. (If `NULL` is passed as the fourth parameter of a `SndRecord` call, the Sound Manager allocates the largest block possible in the application's heap.) If `NewHandle` cannot allocate the block, an error alert is presented and the function returns.

The next block opens the resource fork of the file "SoundResources" and makes it the current resource file.

`SndRecord` opens the sound recording dialog and handles all user interaction until the user clicks the Cancel or Save button. Note that the second parameter of the `SndRecord` call establishes the location for the top left corner of the sound recording dialog and that the third parameter specifies 22kHz, mono, 3:1 compression.

When the user clicks the Save button, the handle is resized automatically. If the user clicks the Cancel button, `SndRecord` returns `userCanceledErr`. If `SndRecord` returns an error other than `userCanceledErr`, an error alert is presented and the function returns after closing the resource fork of the file, disposing of the relocatable block, and restoring the saved resource file reference number.

The relocatable block allocated by `NewHandle`, and resized as appropriate by `SndPlay`, has the structure of a 'snd ' resource, but its handle is not a handle to an existing resource. To save the recorded sound as a 'snd ' resource in the resource fork of the current resource file, the do/while loop first finds an acceptable unique resource ID for the resource. (For the System file, resource IDs for 'snd ' resources in the range 0 to 8191 are reserved for use by Apple Computer, Inc. Avoiding those IDs in this demonstration is not strictly necessary, since there is no intention to move those resources to the System file.)

The call to `AddResource` causes the Resource Manager to regard the relocatable block containing the sound as a 'snd ' resource. If the call is successful, `UpdateResFile` writes the changed resource map and the 'snd ' resource to disk. If an error occurs, an error alert is presented.

The relocatable block is then disposed of, the resource fork of the file “SoundResources” is closed, and the saved resource file reference number is restored.

### **doSpeakStringSync**

`doSpeakStringSync` uses `SpeakString` to speak a specified string resource and takes measures to cause the speech to be generated in a psuedo-synchronous manner.

The speech that `SpeakString` generates is asynchronous, that is, control returns to the application before `SpeakString` finishes speaking the string. In this function, `SpeechBusy` is used to cause the speech activity to be synchronous so far as the function as a whole is concerned. That is, `doSpeakStringSync` will not return until the speech activity is complete.

As a first step, the first line saves the number of speech channels that are active immediately before the call to `SpeakString`.

`GetIndString` loads the first string from the specified 'STR#' resource. If an error occurs, an error alert is presented and the function returns.

`SpeakString`, which automatically allocates a speech channel, is called to speak the string. If `SpeakString` returns an error, an error alert is presented.

Although `SpeakString` returns control to the application immediately it starts generating the speech, the speech channel it opens remains open until the speech concludes. While the speech continues, the number of speech channels open will be one more than the number saved at the first line. Accordingly, the while loop continues until the number of open speech channels is equal to the number saved at the first line. Then, and only then, does `doSpeakStringSync` exit.

### **doPlayResourceASync**

`doPlayResourceASync` uses the `AsynchSoundLib` function `AS_PlayID` to play a 'snd ' resource asynchronously.

#### **NOTE**

The 24194-byte 'snd ' resource being used contains one command only (`bufferCmd`). The compressed sound header indicates no compression. The sound length is 24195 frames. The 8-bit mono sound was sampled at 5kHz.

`AS_PlayID` is called to play the 'snd ' resource specified in the first parameter. Since no further control over the playback is required, `NULL` is passed in the second parameter. (Recall that, if you pass a pointer to a variable in the second parameter, `AS_PlayID` returns a reference number in that parameter. That reference number may be used to gain more control over the playback process. If you simply want to trigger a sound and let it to run to completion, you pass `NULL` in the second parameter, in which case a reference number is not returned by `AS_PlayID`.)

If `AS_PlayID` returns the “no channels currently available” error, an error alert is presented advising of that specific condition. If any other error is returned, a more generalized error message is presented.

When the sound has finished playing, `ASynchSoundLib` advises the application by setting the application’s “attention” flag to true. Recall that this will cause the `ASynchSoundLib` function `AS_CloseChannel` to be called to free up the relevant `ASStructure`, close the relevant sound channel, clear the “attention” flag, and draw some text in the group box to the right of the image well to indicate to the user that `AS_CloseChannel` has just been called.

### **doSpeakStringAsync**

`doSpeakStringAsync` is identical to the function `doSpeakStringSync` except that, in this function, `SpeechBusy` is not used to delay the function returning until the speech activity spawned by `SpeakString` has run its course.

### **doSetUpDialog**

Within `doSetUpDialog`, the Record Sound Resource bevel button is disabled if the program is running on OS X.





## IN THIS CHAPTER

- Notification from Applications in the Background 1398
- Progress Bars Command-Period Key-Down Events, and Mouse-Down Events 1401
- The Color Picker 1402
- Coping with Multiple Monitors 1405
- Help Tags 1407
- Ensuring Compatibility with the Operating Environment 1410
- Carbon and Available APIs 1413
- Main Notification Manager Data Types and Functions 1414
- Relevant Process Manager Data Types and Functions 1415
- Relevant Event Manager Function 1415
- Relevant Color Picker Utilities Function 1415
- Relevant QuickDraw Function 1415
- Relevant Window Manager Function 1416
- Main Help Package Constants, Data Types, and Functions 1416
- Relevant Gestalt Manager Function 1418
- Demonstration Program Miscellany Listing 1418
- Demonstration Program Miscellany Comments 1434



## Notification from Applications in the Background

### The Need for the Notification Manager

Applications running in the background sometimes need to communicate information to the user and need to be certain that the user has actually received that information. The Notification Manager provides for this requirement.

### Elements of a Notification

The Notification Manager creates **notifications**. A notification comprises one or more of five possible elements, which occur in the following sequence:

- A mark appears against the name of the target application in the Mac OS 8/9 Application menu.

This mark is intended to prompt the user to switch the marked application to the foreground. The \_ mark only appears while the application posting the notification remains in the background. It is replaced by the familiar mark when that application is brought to the foreground.

- The Mac OS 8/9 Application menu begins alternating between the target application's icon and the foreground application's icon, or the Apple menu title begins alternating between the target application's icon and the Apple icon.

The location of the icon alternation in the Mac OS 8/9 menu bar is determined by the posting application's mark (if any). If the application posting the notification is marked by either a \_ mark or a \_ mark in the Mac OS 8/9 Application menu, the Application menu title alternates; otherwise the Apple menu title alternates.

Note that several applications might post notifications, so there might be a series of alternating icons.

- On Mac OS 8/9, the Sound Manager plays a sound.

The application posting the notification can request that the system alert sound be used or it can specify its own sound by passing the Notification Manager a handle to a 'snd ' resource.

- On Mac OS 8.6, a modal alert appears, and the user dismisses it (by clicking on the Cancel button). On Mac OS 9.x a floating window appears, allowing the user to continue working in any running application without first dismissing the notification window. On Mac OS X, a system movable modal alert, which remains in front of all other windows, appears.

The application posting the notification specifies the text for the modal alert/floating window/system movable modal alert.

- A response function, if specified, executes.

A response function can be used to remove the notification request from the notification queue (see the following section) or to perform other processing. For example, it can be used to set a global variable to record that the notification was received.

## Notifications in Action

### Overview

The Notification Manager is automatically initialized at system startup.

To present the user with a notification, you create a notification request and install it into the notification queue, which is a standard Macintosh queue. The Notification Manager presents the notification to the user at the earliest possible time.

When appropriate (that is, in the response function or when your application returns to the foreground), you can remove the notification request from the notification queue.

### Creating a Notification Request

#### The Notification Structure

When installing a request into the notification queue, your application must supply a pointer to a notification structure, a static and nonrelocatable structure of type `NMRec`, which indicates the type of notification required. Each entry in the notification queue is a notification structure.

The notification structure is as follows:

```
struct NMRec
{
    QElemPtr  qLink;      // Address of next element in queue. (Used internally.)
    short     qType;      // Type of data. (8 = nmType).
    short     nmFlags;     // (Reserved.)
    long      nmPrivate;   // (Reserved.)
    short     nmReserved; // (Reserved.)
    short     nmMark;      // Application to identify with diamond mark.
    Handle     nmIcon;     // Handle to small icon.
    Handle     nmSound;    // Handle to sound structure.
    StringPtr  nmStr;      // Pointer to string to appear in the notification.
    NMUPP     nmResp;     // Pointer to response function.
    long      nmRefCon;    // Available for application use.
};
typedef struct NMRec NMRec;
typedef NMRec *NMRecPtr;
```

### Field Descriptions

To set up a notification request, you need to fill in at least the first six of the following fields:

- **qType** The type of operating system queue. Set to `nmType (8)`.
- **nmMark** Specifies whether to place a ♦ mark next to the name of the application in the Mac OS 8/9 Application menu. `0` means no mark appears. `1` means the mark appears. Applications should ordinarily set this field to `1`.
- **nmIcon** A handle to an icon family containing a small color icon that is to alternate periodically in the menu bar. If this field is set to `NULL`, no icon appears. The handle must be non-purgeable.
- **nmSound** A handle to a sound resource. If this field is set to `NULL`, no sound is played. If this field is set to `-1`, the system alert sound is played. The handle must be non-purgeable.
- **nmStr** Pointer to a string that appears in the alert/floating window/system movable modal alert. If this field is set to `NULL`, no alert/ floating window/system movable modal alert appears. Your application should not dispose of this storage until it removes the notification request.
- **nmResp** Universal procedure pointer to a response function. If this field is set to `NULL`, no response function executes when the notification is posted. If this field is set to `-1`, a pre-defined function removes the notification request when it has completed. However, on Mac OS 8/9, if either **nmMark** or **nmIcon** is non-zero, do not set **nmResp** to `-1`, because the Notification Manager will remove the \_ mark or the icon before the user sees it.
- If you do not need to do any processing in response to the notification, you should set this field to `NULL`. If you supply a universal procedure pointer to your own response function, the Notification Manager passes your response function one parameter, namely, a universal procedure pointer to your notification structure. Accordingly, this is how you would declare a response function having the name `theResponse`:  

```
void theResponse(NMUPP nmStructurePtr);
```
- You can use response functions to remove notification requests from the notification queue, free any memory, or set a global variable in your application to record that the notification was posted.
- An *nmResp* value of `-1` does not free the memory block containing the queue element; it merely removes that element from the notification queue.
- **nmRefCon** For your application's own use.

## Installing a Notification Request

`NMInstall` is used to add a notification request to the notification queue. The following is an example call:

```
osError = NMInstall(&notificationStructure);
```

Before calling `NMInstall`, you should make sure that your application is running in the background. If your application is in the foreground, you simply use standard alert methods, rather than the Notification Manager, to gain the user's attention.

## Removing a Notification Request

`NMRemove` is used to remove a notification request from the notification queue. The following is an example call:

```
osError = NMRemove(&notificationStructure);
```

You can remove requests at any time, either before or after the notification actually occurs.

On Mac OS 9.x and Mac OS X the user does not have to dismiss the notification before being able to activate the application. For this reason, when your application is running on Mac OS 9.x or Mac OS X, may wish to have it explicitly cancel the notification using `NMRemove` when the application becomes active.

# Progress Bars, Command-Period Key-Down Events, and Mouse-Down Events

## Progress Bars

Operations within an application that tie up the machine for relatively brief periods of time should be accompanied by a cursor shape change to the watch cursor or perhaps to an animated cursor (Mac OS 8/9) or by an invocation of the wait cursor (Mac OS X). On the other hand, lengthy operations should be accompanied by the display of a progress indicator.

The progress indicator control was described in Chapter 14. A progress indicator created using this control may be determinate or indeterminate. Determinate progress indicators show how much of the operation has been completed. Indeterminate progress indicators show that an operation is occurring but does not indicate its duration. Ordinarily, progress indicators should be displayed within a dialog.

As stated in Chapter 2, your application should allow the user to cancel a lengthy operation using the Command-period key combination.

## Scanning for Command-Period Key-Down Events

The function `CheckEventQueueForUserCancel` may be used to scan the event queue for Command-period key-down events, and will return `true` if a Command-period event is found. If `true` is returned, the lengthy operation should be terminated and the dialog displaying the progress indicator should be closed.

## The Color Picker

The Color Picker Utilities provide your application with:

- A standard dialog, called the Color Picker, for soliciting a color choice from the user.
- Functions for converting color specifications from one color model to another.

## Color Models

In the world of color, three main color models are used to specify a particular color. These are the RGB (red, green, blue) model, the CYMK (cyan, magenta, yellow, black) model, and the HLS or HSV (hue, lightness, saturation, or hue, saturation, value) models.

### RGB Model

The RGB model is used where light-produced colors are involved, as in the case of a television set, computer monitor, or stage lighting. In this model, the three primary colors involved (red, green, and blue) are said to be *additive* because, the more of each color you add, the closer the resulting color is to white.

### CYMK Model

The CYMK model is closely associated with printing, that is, putting color on a white page. In this model, the three primary colors (cyan, yellow, and magenta) are said to be *subtractive* because, the more of each color you add, the closer the resulting color is to black. (The inclusion of black in the model accounts for the fact that the colors of printers' inks may vary slightly from true cyan, yellow, and magenta, meaning that a true black may not be achievable with just a CYM model.)

#### NOTE

Cyan, magenta, and yellow are the complements of red, green, and blue.

## HLS and HSV Models

The HLS and HSV models separate color (that is, hue) from saturation and brightness. Saturation is a measure of the amount of white in a color (the less white, the more saturated the color). Lightness is the measure of the amount of black in a color. (The less black, the lighter the color). The amount of black is specified by the lightness (L) value in the HLS model and by the value (V) value in the HSV model.

The HSL/HLV model may be represented diagrammatically by the HSL/HLV color cone shown in Fig 1. In this color cone, hue is represented by an angle between  $0^\circ$  and  $360^\circ$ .

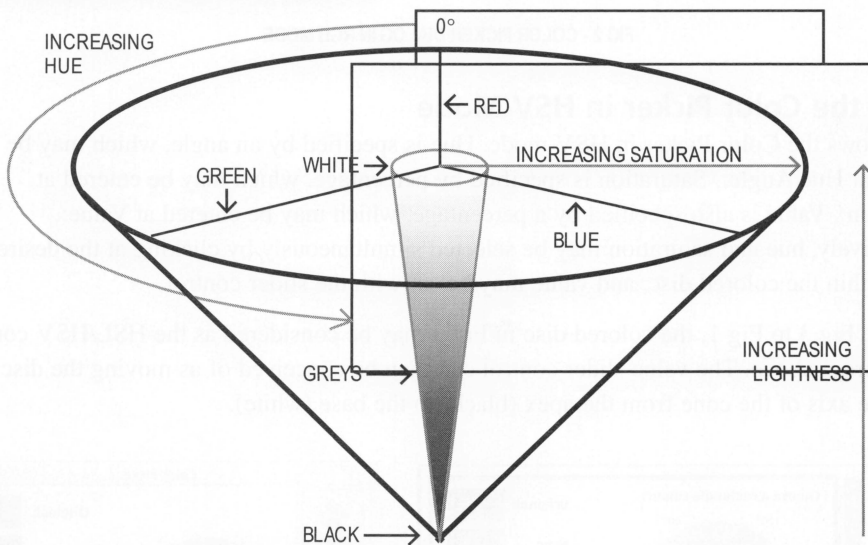


FIG 1 - HSL/HSV COLOUR CONE

## The Color Picker

The Color Picker allows the user to specify a color using either the RGB, CMYK, HLS, or HSV, models.

### Using the Color Picker RGB Mode

Fig 2 shows the Color Picker in RGB mode. The desired red, green, and blue values may be set using the three slider controls or may be entered directly into the edit text fields on the right of the sliders.



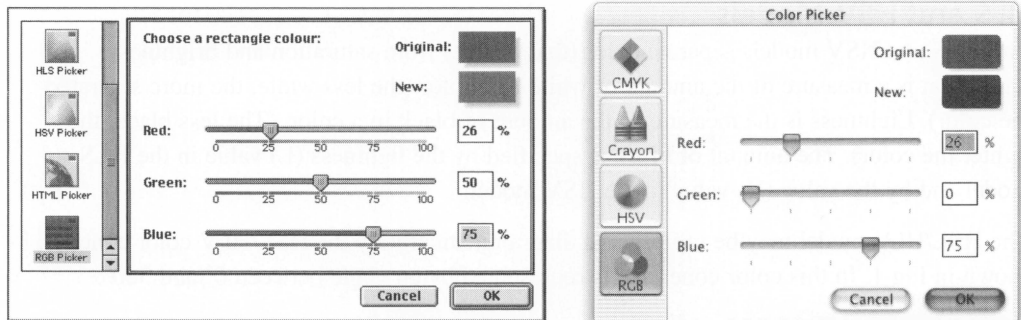


FIG 2 - COLOR PICKER DIALOG IN RGB MODE

## Using the Color Picker in HSV Mode

Fig 3 shows the Color Picker in HSV mode. Hue is specified by an angle, which may be entered at Hue Angle:. Saturation is specified by percentage, which may be entered at Saturation:. Value is also specified by a percentage, which may be entered at Value:. Alternatively, hue and saturation may be selected simultaneously by clicking at the desired point within the colored disc, and value may be set with the slider control.

To relate Fig 3 to Fig 1, the colored disc in Fig 3 may be considered as the HSL/HSV cone as viewed from above. The value slider control can then be conceived of as moving the disc up or down the axis of the cone from the apex (black) to the base (white).

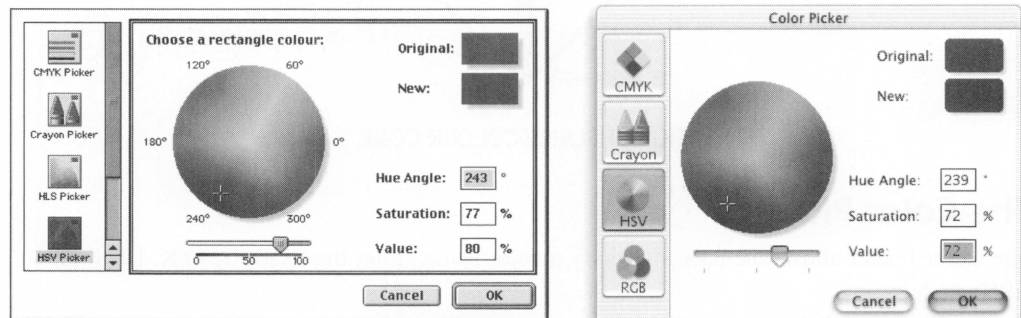


FIG 3 - COLOR PICKER DIALOG IN HLS MODE

## Invoking the Color Picker

The Color Picker is invoked using the GetColor function:

```
Boolean GetColor(Point where,ConstStr255Param prompt,const RGBColor *inColor,
                RGBColor *outColor);
```

**Returns:** A Boolean value indicating whether the user clicked on the OK button or Cancel button.

**Where** Dialog's upper-left corner.  $(0,0)$  causes the dialog to be positioned centrally on the main screen.

**prompt** A prompt string, which is displayed in the upper left corner of the main pane in the dialog.

**inColor** The starting color, which the user may want for comparison, and which is displayed against Original: in the top-right corner of the dialog.

**outColor** Initially set to equal **inColor**. Assigned a new value when the user picks a color. The color stored in this parameter is displayed at the top right of the dialog against New:.)

If the user clicks the OK button in the Color Picker dialog, your application should adopt the **outColor** value as the color chosen by the user. If the user clicks the Cancel button, your application should assume that the user has decided to make no color change, that is, the color should remain as that represented by the **inColor** parameter.

## Coping with Multiple Monitors

### Overview

In a multi-monitor system, the user may specify which of the attached monitors is to be the main screen (that is, the screen containing the menu bar) and to set the position of the other screen, or screens, relative to the main screen.

The maximum number of colors capable of being displayed by a given Macintosh at the one time is determined by the video capability of that particular Macintosh. The maximum number of colors capable of being displayed on a given screen at the one time depends on settings made by the user. In a multi-monitor environment, therefore, it is possible for each screen to be set to a different pixel depth.

In more technical terms, the user's settings set the pixel depth of a particular video device. A brief review of the subject of video devices is therefore appropriate at this point.

### Video Devices Revisited

As stated in Chapter 11

- A **graphics device** is anything into which QuickDraw can draw, a **video device** (such as a plug-in video card or a built-in video interface) is a graphics device that controls screens, QuickDraw stores information about video devices in **GDevice** structures, the system creates and initializes a **GDevice** structure for each video device found during start-up all structures are linked together in a list called the **device list**, and the global variable **DeviceList** holds a handle to the first structure in the list.



- At any given time only one graphics device is the **current device**, that is, the one in which the drawing is taking place. A handle to the current device's GDevice structure is placed in the global variable TheGDevice.

#### NOTE

The current device is sometimes referred to as the **active device**.

By default, the GDevice structure corresponding to the first video device found at start up is marked as the (initial) current device, and all other graphics devices in the list are initially marked as inactive. When the user moves a window to, or creates a window on, another screen, and your application draws into that window, QuickDraw automatically makes the video device for that screen the current device and stores that information in TheGDevice. As QuickDraw draws across a user's video devices, it keeps switching to the GDevice structure for the video device on which it is actively drawing.

## Requirements of the Application

### Image Optimization

To draw a particular graphic, your application may have to call different drawing functions for that graphic depending on the characteristics of the video device intersecting your window's drawing region, the aim being to optimize the appearance of the image regardless of whether it is being displayed on a grayscale device or a color device. Recall from Chapter 11 that when QuickDraw displays a color on a grayscale screen, it computes the luminance, or intensity of light, of the desired color and uses that value to determine the appropriate gray value to draw. It is thus possible that, for example, two overlapping objects drawn in two quite different colors on a color screen may appear in the same shade of gray on a grayscale screen. In order for the user to differentiate between these two objects on a grayscale screen, you would need to provide an alternative drawing function which draws the two objects in different shades of gray on grayscale screens.

The QuickDraw function DeviceLoop is central to the matter of optimizing the appearance of your images. DeviceLoop searches for graphics devices that intersect your window's drawing region, informing your application of each graphics device it finds, and providing your application with information about the current device's attributes. Armed with this information, your application can then invoke whichever of its drawing functions is optimized for those particular attributes.

DeviceLoop's second parameter is a pointer to an application-defined (callback) function. That function must be defined like this:

```
void myDrawingFunction(short depth, short deviceFlags, GDHandle targetDevice,
                      long userData)
```

DeviceLoop calls this function for each dissimilar video device it finds. If it encounters similar devices (that is, devices having the same pixel depth, color table seeds, etc.) it will make only one call to myDrawingFunction, pointing to the first such device encountered.

## Other Requirements—Classic Event Model Applications

Other requirements, for Classic event model applications only, are as follows:

- **Window Zooming.** If the user drags a window currently zoomed to the user state so that it spans two screens, and then clicks the zoom box to zoom the window to the standard state, the window should be zoomed to the standard state on the screen that contained the largest area of the window before the zoom box was clicked. The function `ZoomWindowIdeal`, which was introduced with Mac OS 8.5, zooms windows in accordance with this requirement.
- **Window Dragging.** In Carbon, if `NULL` is passed in `DragWindow`'s `boundsRect` parameter, the bounding rectangle limiting the area in which the window can be dragged is set to the desktop region, which, in a multi-monitors environment, includes all screen real estate less the menu bar.
- **Window Sizing.** In a multi-monitor environment, if you pass a constraining rectangle in `ResizeWindow`'s `sizeConstraints` parameter, that rectangle should be based on the bounding rectangle of the desktop region. You should call `GetGrayRgn` to get a handle to the desktop region and then call `GetRegionBounds` to get that region's bounding rectangle.

## Constraining a Window to One Screen

In a multimonitor environment, a call to the function `ConstrainWindowToScreen` enables you to constrain a window's movement and resizing so that it is contained entirely on a single screen.

## Help Tags

Help tags are the equivalent, on Mac OS X, of Help balloons on Mac OS 8/9, and appear when the cursor hovers over a user interface element. Carbon also supports Help tags on Mac OS 8/9; however, you may consider that, compared with Help balloons, their "look" is somewhat at odds with the Platinum appearance.

## Human Interface Guidelines

Guidelines for Help tags are at

<http://developer.apple.com/techpubs/macosx/Carbon/pdf/UsingHelpTags.pdf>.

## Creating Help Tags

You create a Help tag for a control by filling in the fields of an `HMHelpContentRec` structure and its associated `HMHelpContent` structure and passing the control reference and the address of the `HMHelpContentRec` structure in a call to the function `HMSetControlHelpContent`.

## Data Types

The `HMHelpContentRec` and `HMHelpContent` structures are as follows:

```
struct HMHelpContentRec
{
    SInt32          version;
    Rect            absHotRect;
    HMTAGDisplaySide tagSide;
    HMHelpContent   content[2];
};
typedef struct HMHelpContentRec HMHelpContentRec;
typedef HMHelpContentRec *HMHelpContentPtr;

struct HMHelpContent
{
    HMContentType   contentType;
    union
    {
        {
            CFStringRef   tagCFString;    // A CFStringRef reference.
            Str255         tagString;      // A Pascal string.
            HMStringResType tagStringRes;  // A 'STR#' resource ID and index.
            TEHandle       tagTEHandle;    // A TextEdit handle. (Mac OS 8/9 only.)
            SInt16         tagTextRes;     // A 'TEXT'/'styl' resource ID. (Mac OS 8/9 only.)
            SInt16         tagStrRes;      // A 'STR ' resource ID
        }
        u;
    };
};
typedef struct HMHelpContent HMHelpContent;
```

The `HMStringResType` structure is used to specify the resource ID and index when Help tag content is sourced from a 'STR#' resource:

```
struct HMStringResType
{
    short hmmResID; // Resource ID of 'STR#' resource.
    short hmmIndex; // 'STR#' resource index.
};
typedef struct HMStringResType HMStringResType;
```

Note that the `content` field of the `HMHelpContentRec` structure is a two-element array. The second element allows you to provide an expanded version of the Help tag message when the user presses the Command key.

## Constants

Typical constants relevant to the `tagSide` field of the `HMHelpContentRec` structure are as follows:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kHMDefaultSide</code>	0	System default location.
<code>kHMOutsideTopScriptAligned</code>	1	Above, aligned with left or right depending on system script.
<code>kHMOutsideLeftCenterAligned</code>	2	To the left, centered vertically.
<code>kHMOutsideRightCenterAligned</code>	4	To the right, centered vertically.
<code>kHMOutsideTopLeftAligned</code>	5	Above, aligned with left.
<code>kHMOutsideTopRightAligned</code>	6	Above, aligned with right.
<code>kHMOutsideLeftTopAligned</code>	7	To the left, aligned with top.
<code>kHMOutsideLeftBottomAligned</code>	8	To the left, aligned with bottom.
<code>kHMOutsideBottomLeftAligned</code>	9	Below, aligned with left.
<code>kHMOutsideBottomRightAligned</code>	10	Below, aligned with right.

Constants relevant to the `content` field of the `HMHelpContentRec` structure are as follows:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kHMMinimumContentIndex</code>	0	First element of content array.
<code>kHMMaximumContentIndex</code>	1	Second element of content array.

Constants relevant to the `contentType` field of the `HMHelpContent` structure are as follows:

<i>Constant</i>	<i>Value</i>	<i>Description</i>
<code>kHMNoContent</code>	'none'	No content.
<code>kHMCFStringContent</code>	'cfst'	Content sourced from a <code>CFStringRef</code> reference.
<code>kHMPascalStrContent</code>	'pstr'	Content sourced from a Pascal string.
<code>kHMStringResContent</code>	'str#'	Content sourced from a 'STR#' resource.
<code>kHMTCHandleContent</code>	'txth'	Content sourced from a <code>TextEdit</code> handle. (Mac OS 8/9 only.)
<code>kHMTextResContent</code>	'text'	Content sourced from 'TEXT'/'styl' resources. (Mac OS 8/9 only.)
<code>kHMStrResContent</code>	'str '	Content sourced from a 'STR ' resource.

## Help Tags for Windows

You create a Help tag for a window in the same way you do for a control, except that

- You call the function `HMSetWindowHelpContent` instead of `HMSetControlHelpContent`.
- You assign the window's port rectangle, converted to global coordinates, to the `absHotRect` field of the `HMHelpContentRec` structure.
- You must call `HMSetControlHelpContent` again whenever the window size or position changes to ensure that the hot rectangle coordinates are updated.

## Help Tags for Menus

You create Help tags for menu titles and items in the same way as you do for a control, except that you call the function `HMSetMenuItemHelpContent` instead of `HMSetControlHelpContent`.

At the time of writing, menu title and menu item Help tags were not supported by Carbon or CarbonLib. However, future support was planned.

## Setting the Delay Before Tag Display

You can set the delay, in milliseconds, before a tag opens by calling the function `HMSetTagDelay`.

## Enabling and Disabling Help Tags

You can enable and disable help tags using the function `HMSetHelpTagsDisplayed`, and you can determine whether Help tags are currently enabled using the function `HMAreHelpTagsDisplayed`.

## Ensuring Compatibility with the Operating Environment

If your application is to run successfully in the software and hardware environments that may be present in a wide range of Macintosh models, it must be able to acquire information about a number of machine-dependent features and, where appropriate, act on that information.

## The Gestalt Function

The `Gestalt` function may be used to acquire a wide range of information about the operating environment.

```
OSErr Gestalt(OSType selector, long *response);
```

**Returns:** Error code. (0 = no error.)

**Selector** Selector code.

**Response** 4-byte return result which provides the requested information. When all four bytes are not needed, the result is expressed in the low-order byte.

The types of information capable of being retrieved by `Gestalt` are as follows:

- The type of machine.
- The version of the System file currently running.
- The type of CPU.
- The type of keyboard attached to the machine.
- The type of floating-point unit (FPU) installed, if any.
- The type of memory management unit (MMU).
- The size of the available RAM.
- The amount of available virtual memory.
- The versions and features of various drivers and managers.

## Gestalt Selectors

To use `Gestalt`, you pass it a selector, which specifies exactly what information your application is seeking. Of those selectors that are pre-defined by the Gestalt Manager, there are two sub-types:

- **Environmental Selectors.** Environmental selectors are those that return information about the existence, or otherwise, of a feature. This information can be used by your application to guide its actions. Some examples of the many available environmental selectors, and the information returned in the response parameter, are as follows:

<i>Selector</i>	<i>Information Returned</i>
<code>gestaltFPUType</code>	FPU type.
<code>gestaltKeyboardType</code>	Keyboard type.
<code>gestaltPhysicalRAMSize</code>	Physical RAM size.
<code>gestaltQuickdrawVersion</code>	QuickDraw version.
<code>gestaltTextEditVersion</code>	TextEdit version.

- **Informational Selectors.** Informational selectors are those that provide information that should be used for the user's enlightenment only. This information should never be used as proof positive of some feature's existence, nor should it be used to guide your application's actions. `gestaltMachineType` is an example of an informational selector.

## Gestalt Responses

In most cases, the last few characters in the selector's name form a suffix that indicates the type of value that will be returned in the response parameter. The following shows the meaningful suffixes:

<i>Suffix</i>	<i>Returned Value</i>
Attr	A range of 32 bits, the meaning of which must be determined by comparison with a list of constants.
Count	A number indicating how many of the indicated type of items exist.
Size	A size, usually in bytes.
Table	Base address of a table.
Type	An index describing a particular type of feature.
Version	A version number. Implied decimal points may separate digits of the returned value. For example, a value of <code>0x0910</code> returned in response to the <code>gestaltSystemVersion</code> selector means that system software version 9.1.0 is present.

## Using Gestalt

The header file `Gestalt.h` defines and describes Gestalt Manager selectors, together with the many constants, which may be used to test the response parameter.

### Example 1

For example, when `Gestalt` is used to check whether Version 1.3 or later of Color QuickDraw is present, the value returned in the response parameter may be compared with `gestalt32BitQD13` as follows:

```
OSErr  osErr
SInt32 response;
Boolean colorQuickDrawVers13Present = true;

osErr = Gestalt(gestaltQuickdrawVersion, &response);
if (osErr == noErr)
{
    if (response < gestalt32BitQD13)
        colorQuickDrawVers13Present = false;
}
```

### Example 2

Many constants in `Gestalt.h` represent bit numbers. In this example, the value returned in the response parameter is tested to determine whether bit number 5 (`gestaltHasSoundInputDevice`) is set:



```

OSErr  osErr;
SInt32 response;
Boolean hasSoundInputDevice = false;

osErr = Gestalt(gestaltSoundAttr,&response);
if(osErr == noErr)
    gHasSoundInputDevice = BitTst(&response,31 - gestaltHasSoundInputDevice);

```

Note that the function `BitTst` is used to determine whether the specified bit is set. Bit numbering with `BitTst` is the opposite of the usual MC680x0 numbering scheme used by `Gestalt`. Thus the bit to be tested must be subtracted from 31. This is illustrated in the following:

```

Bit numbering as used in BitTst
0  1  2  3  4  5  6  7  8  9  10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Bit as numbered in MC69000 CPU operations, and used by Gestalt
15 14 13 12 11 10 9  8  7  6  5  4  3  2  1  0  15 14 13 12 11 10 9  8  7  6  5  4  3  2  1  0

gestaltHasSoundInputDevice = 5
31 - 5 = 26

```

## Carbon and Available APIs

### CarbonLib and the Underlying Mac OS 8/9 System Software

CarbonLib (the implementation of the Carbon API for Mac OS 8/9) does not, in general, implement new APIs on old systems. It is basically a “pass-through” library that re-exports what is available on the underlying system software.

Thus, if your application calls a function introduced with Mac OS 9.0, it will compile correctly because that function is, by definition, part of the Carbon API (all new function introduced from Mac OS 8.5 onwards are supported by Carbon); however, if the application is run on Mac OS 8.6, the call to that function will fail.

There are a few exceptions to this rule, for example, the menu, control, and window property APIs.

### Interpreting Universal Headers Comments

When you run a CFM application on Mac OS X, CFM follows the same rules for runtime linkages as it does on Mac OS 8/9. Since the application links against a library named CarbonLib, there needs to be a CFM library named CarbonLib somewhere on Mac OS X.

That library is `/System/Library/CFM Support/CarbonLib`. It exports all of the APIs as does CarbonLib on Mac OS 8/9, plus some APIs that are only implemented on Mac OS X. (Those exports, incidentally, are not the real implementations but simply glue that transfers control from the CFM library to the Mach-O frameworks, where the APIs are really implemented. Frameworks are like Mac OS 8/9 shared libraries.)



In the Universal Headers, a comment like:

```
CarbonLib:  in CarbonLib 1.1 and later
```

means that the API is implemented in CarbonLib for Mac OS 8/9 and exported from the CarbonLib library on Mac OS X. This comment

```
CarbonLib:  in CarbonLib on Mac OS X
```

means that the API is not implemented in CarbonLib for Mac OS 8/9 but is still exported from the CarbonLib library on Mac OS X. The real determinant of whether an API is available in Carbon.framework is this comment:

```
Mac OS X:   in version 10.0 or later
```

If the comment in CarbonLib on Mac OS X applies to a function called in your application, you must add the stub library CarbonFrameworkLib to the CodeWarrior project.

## T-Vector Tests

In Carbon, the recommended method for checking the availability of a routine is to check its T-Vector (transition vector) directly, as in the following example.

```
if((UInt32) CreateStandardSheet == (UInt32) kUnresolvedCFragSymbolAddress)
    // CreateStandardSheet is not available. Do this.
else
    // Do this.
```

# Main Notification Manager Data Types and Functions

## Data Types

### Notification Structure

```
struct NMRec
{
    QElemPtr  qLink;        // Next queue entry.
    short     qType;        // Queue type.
    short     nmFlags;      // (Reserved.)
    long      nmPrivate;    // (Reserved.)
    short     nmReserved;   // (Reserved.)
    short     nmMark;       // Item to mark in Apple menu.
    Handle    nmIcon;       // Handle to small icon.
    Handle    nmSound;      // Handle to sound structure.
    StringPtr nmStr;        // String to appear in notification.
    NMUPP     nmResp;       // Pointer to response function.
    long      nmRefCon;     // For application use.
};
typedef struct NMRec NMRec;
typedef NMRec *NMRecPtr;
```

## Functions

### Add Notification Request to the Notification Queue

```
OSErr NMInstall(NMRecPtr nmReqPtr);
```

### Remove Notification Request from the Notification Queue

```
OSErr NMRemove(NMRecPtr nmReqPtr);
```

## Relevant Process Manager Data Types and Functions

### Data Types

#### Process Serial Number

```
struct ProcessSerialNumber
{
    unsigned long    highLongOfPSN;
    unsigned long    lowLongOfPSN;
};
```

### Functions

#### Getting Process Serial Numbers

```
OSErr GetCurrentProcess(ProcessSerialNumber *PSN);
OSErr GetFrontProcess(ProcessSerialNumber *PSN);
```

#### Comparing Two Process Serial Numbers

```
OSErr SameProcess(const ProcessSerialNumber *PSN1,const ProcessSerialNumber *PSN2,
    Boolean *result);
```

## Relevant Event Manager Function

### Check For Command-Period

```
Boolean CheckEventQueueForUserCancel(void);
```

## Relevant Color Picker Utilities Function

```
Boolean GetColor(Point where,ConstStr255Param prompt,const RGBColor *inColor,
    RGBColor *outColor);
```

## Relevant QuickDraw Function

### Drawing Across Multiple Video Devices

```
void DeviceLoop(RgnHandle drawingRgn,DeviceLoopDrawingUP drawingProc,long userData,
    DeviceLoopFlags flags);
```

## Relevant Window Manager Function

```
OSStatus ConstrainWindowToScreen(WindowRef inWindowRef, WindowRegionCode inRegionCode,
                                WindowConstrainOptions inOptions, const Rect *inScreenRect,
                                Rect *outStructure);
```

## Main Help Package Constants, Data Types, and Functions

### Constants

#### Content Type

kHMNoContent	= FOUR_CHAR_CODE('none')
kHMCFStringContent	= FOUR_CHAR_CODE('cfst')
kHMPascalStrContent	= FOUR_CHAR_CODE('pstr')
kHMStringResContent	= FOUR_CHAR_CODE('str#')
kHMTCHandleContent	= FOUR_CHAR_CODE('txth')
kHMTextResContent	= FOUR_CHAR_CODE('text')
kHMStrResContent	= FOUR_CHAR_CODE('str ')

#### Tag Display Side

kHMDefaultSide	= 0
kHMOutsideTopScriptAligned	= 1
kHMOutsideLeftCenterAligned	= 2
kHMOutsideBottomScriptAligned	= 3
kHMOutsideRightCenterAligned	= 4
kHMOutsideTopLeftAligned	= 5
kHMOutsideTopRightAligned	= 6
kHMOutsideLeftTopAligned	= 7
kHMOutsideLeftBottomAligned	= 8
kHMOutsideBottomLeftAligned	= 9
kHMOutsideBottomRightAligned	= 10
kHMOutsideRightTopAligned	= 11
kHMOutsideRightBottomAligned	= 12
kHMOutsideTopCenterAligned	= 13
kHMOutsideBottomCenterAligned	= 14
kHMInsideRightCenterAligned	= 15
kHMInsideLeftCenterAligned	= 16
kHMInsideBottomCenterAligned	= 17
kHMInsideTopCenterAligned	= 18
kHMInsideTopLeftCorner	= 19
kHMInsideTopRightCorner	= 20
kHMInsideBottomLeftCorner	= 21
kHMInsideBottomRightCorner	= 22
kHMAbsoluteCenterAligned	= 23

#### For HMHelpContentRec.content

kHMMinimumContentIndex	= 0
kHMMaximumContentIndex	= 1

## Data Types

```
typedef UInt32 HMContentType;
typedef SInt16 HMTAGDisplaySide;
```

### HelpContent

```
struct HMHelpContent
{
    HMContentType    contentType;
    union
    {
        CFStringRef    tagCFStringRef;
        Str255          tagString;
        HMStringResType tagStringRes;
        TEHandle        tagTEHandle;
        SInt16          tagTextRes;
        SInt16          tagStrRes;
    }                u;
};
typedef struct HMHelpContent HMHelpContent;
```

### HMHelpContentRec

```
struct HMHelpContentRec
{
    SInt32          version;
    Rect            absHotRect;
    HMTAGDisplaySide tagSide;
    HMHelpContent    content[2];
};
typedef struct HMHelpContentRec HMHelpContentRec;
typedef HMHelpContentRec *HMHelpContentPtr;
```

### HMStringResType

```
struct HMStringResType
{
    short hmmResID;
    short hmmIndex;
};
typedef struct HMStringResType HMStringResType;
```

## Functions

### Installing and Retrieving Content

```
OSStatus HMSetControlHelpContent(ControlRef inControl,const HMHelpContentRec *inContent);
OSStatus HMGetControlHelpContent(ControlRef inControl,HMHelpContentRec *outContent);
OSStatus HMSetWindowHelpContent(WindowRef inWindow,const HMHelpContentRec *inContent);
OSStatus HMGetWindowHelpContent(WindowRef inWindow,HMHelpContentRec *outContent);
OSStatus HMSetMenuItemHelpContent(MenuRef inMenu,MenuItemIndex inItem,
    const HMHelpContentRec *inContent);
OSStatus HMGetMenuItemHelpContent(MenuRef inMenu,MenuItemIndex inItem,
    HMHelpContentRec *outContent);
```

### Enabling and Disabling Help Tags

```
Boolean  HMAreHelpTagsDisplayed(void);
OSStatus HMSetHelpTagsDisplayed(Boolean inDisplayTags);
```

### Setting and Getting Tag Delay

```
OSStatus HMSetTagDelay(Duration inDelay);
OSStatus HMGetTagDelay(Duration *outDelay);
```

### Displaying Tags

```
OSStatus HMDisplayTag(const HMHelpContentRec *inContent);
```

## Relevant Gestalt Manager Function

```
OSErr    Gestalt(OSType selector, long *response);
```

## Demonstration Program Miscellany Listing

```
// *****
// Miscellany.h                                     CARBON EVENT MODEL
// *****
//
// This program demonstrates:
//
// • The use of the Notification Manager to allow an application running in the background to
//   to communicate with the foreground application.
//
// • The use of the determinate progress bar control to show progress during a time-
//   consuming operation, together with scanning the event queue for Command-period key-down
//   events for the purpose of terminating the lengthy operation before it concludes of its
//   own accord.
//
// • The use of the Color Picker to solicit a choice of color from the user.
//
// • Image drawing optimisation in a multi-monitors environment.
//
// • Help tags for controls and windows with minimum and maximum content.
//
// The program utilises the following resources:
//
// • A 'plst' resource.
//
// • An 'MBAR' resource, and 'MENU' resources for Apple, File, Edit and Demonstration menus
//   (preload, non-purgeable).
//
// • A 'DLOG' resource (purgeable), and associated 'DITL', 'dlgx', and 'dftb' resources
//   (purgeable), for a dialog box in which the progress indicator is displayed.
//
// • 'CNTL' resources (purgeable) for the progress indicator dialog.
//
// • 'icn#', 'ics4', and 'ics8' resources (non-purgeable) which contain the application icon
//   shown in the Application menu during the Notification Manager demonstration.
//
```

```
// · A 'snd ' resource (non-purgeable) used in the Notification Manager demonstration.
//
// · A 'STR ' resource (non-purgeable) containing the text displayed in the alert box invoked
// by the Notification Manager.
//
// · 'STR#' resources (purgeable) containing the label and narrative strings for the
// notification-related alert displayed by Miscellany and the minimum and maximum Help tag
// content.
//
// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
// doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****
// ..... includes

#include <Carbon.h>

// ..... defines

#define rMenubar          128
#define mAppleApplication 128
#define iAbout            1
#define mFile             129
#define iQuit             12
#define mDemonstration    131
#define iNotification     1
#define iProgress         2
#define iColorPicker      3
#define iMultiMonitors    4
#define iHelpTag          5
#define rWindow           128
#define rDialog           128
#define iProgressIndicator 1
#define rIconFamily       128
#define rBarkSound        8192
#define rString            128
#define rAlertStrings     128
#define indexLabel        1
#define indexNarrative    2
#define rPicture           128
#define topLeft(r)         (((Point *) &(r))[0])
#define botRight(r)        (((Point *) &(r))[1])

// ..... function prototypes

void      main                                (void);
void      doPreliminaries                    (void);
OSStatus  appEventHandler                    (EventHandlerCallRef, EventRef, void *);
OSStatus  windowEventHandler                 (EventHandlerCallRef, EventRef, void *);
void      doMenuChoice                       (MenuID, MenuItemIndex);
```

```

void      doSetUpNotification      (void);
void      doPrepareNotificationStructure (void);
void      doIdle                   (void);
void      doDisplayMessageToUser   (void);

void      doProgressBar            (void);

void      deviceLoopDraw           (SInt16,SInt16,GDHandle,SInt32);

void      doColorPicker            (void);
void      doDrawColorPickerChoice  (void);
char      *doDecimalToHexadecimal  (UInt16 n);

void      doHelpTagControl         (void);
void      doHelpTagWindow          (void);

// *****
// Miscellany.c
// *****

#include "Miscellany.h"

// ..... global variables

DeviceLoopDrawingUPP gDeviceLoopDrawUPP;
WindowRef            gWindowRef;
ControlRef           gBevelButtonControlRef;
ProcessSerialNumber  gProcessSerNum;
Boolean              gMultiMonitorsDrawDemo = false;
Boolean              gColorPickerDemo = false;
Boolean              gHelpTagsDemo = false;
RGBColor             gWhiteColor = { 0xFFFF, 0xFFFF, 0xFFFF };
RGBColor             gBlueColor = { 0x6666, 0x6666, 0x9999 };

extern Boolean        gNotificationInQueue;

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32         response;
    MenuRef        menuRef;
    Rect           contentRect = { 100,100,402,545 };
    Rect           portRect;
    Rect           controlRect = { 65,10,155,100 };
    EventTypeSpec  applicationEvents[] = { { kEventClassApplication, kEventAppActivated },
                                           { kEventClassCommand,      kEventProcessCommand } };
    EventTypeSpec  windowEvents[]      = { { kEventClassWindow, kEventWindowDrawContent },
                                           { kEventClassWindow, kEventWindowGetIdealSize },
                                           { kEventClassWindow, kEventWindowGetMinimumSize },
                                           { kEventClassWindow, kEventWindowBoundsChanged } };

```

```

// ..... do preliminaries

doPreliminaries();

// ..... create universal procedure pointer

gDeviceLoopDrawUPP = NewDeviceLoopDrawingUPP((DeviceLoopDrawingProcPtr) deviceLoopDraw);

// ..... set up menu bar and menus

menubarHdl = GetNewMBar(rMenubar);
if(menubarHdl == NULL)
    ExitToShell();
SetMenuBar(menubarHdl);
DrawMenuBar();

Gestalt(gestaltMenuMgrAttr,&response);
if(response & gestaltMenuMgrAquaLayoutMask)
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
    {
        DeleteMenuItem(menuRef,iQuit);
        DeleteMenuItem(menuRef,iQuit - 1);
        DisableMenuItem(menuRef,0);
    }
}
else
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
        SetMenuItemCommandID(menuRef,iQuit,kHICCommandQuit);
}

// ..... install application event handler and timer

InstallApplicationEventHandler(NewEventHandlerUPP((EventHandlerProcPtr) appEventHandler),
                             GetEventTypeCount(applicationEvents),applicationEvents,
                             0,NULL);

InstallEventLoopTimer(GetCurrentEventLoop(),0,1,
                      NewEventLoopTimerUPP((EventLoopTimerProcPtr) doIdle),NULL,NULL);

// ..... open window

CreateNewWindow(kDocumentWindowClass,kWindowStandardHandlerAttribute |
               kWindowStandardDocumentAttributes,&contentRect,&gWindowRef);

ChangeWindowAttributes(gWindowRef,0,kWindowCloseBoxAttribute);
SetWTitle(gWindowRef," \pMiscellany");
RepositionWindow(gWindowRef,NULL,kWindowAlertPositionOnMainScreen);

SetPortWindowPort(gWindowRef);
TextSize(10);

```



```

ShowWindow(gWindowRef);
GetWindowPortBounds(gWindowRef,&portRect);
InvalWindowRect(gWindowRef,&portRect);

// ..... install window event handler

InstallWindowEventHandler(gWindowRef,
    NewEventHandlerUPP((EventHandlerProcPtr) windowEventHandler),
    GetEventTypeCount(windowEvents),windowEvents,0,NULL);

// ..... create control and help tags

CreateBevelButtonControl(gWindowRef,&controlRect,CFSTR("Control"),
    kControlBevelButtonNormalBevel,kControlBehaviorPushbutton,
    NULL,0,0,0,&gBevelButtonControlRef);

doHelpTagControl();
HideControl(gBevelButtonControlRef);
doHelpTagWindow();
HMSetHelpTagsDisplayed(false);

// ..... get process serial number of this process

GetCurrentProcess(&gProcessSerNum);

// ..... run application event loop

RunApplicationEventLoop();
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(640);
    InitCursor();
}

// ***** appEventHandler

OSStatus appEventHandler(EventHandlerCallRef eventHandlerCallRef,EventRef eventRef,
    void * userData)
{
    OSStatus    result = eventNotHandledErr;
    UInt32      eventClass;
    UInt32      eventKind;
    HICommand   hiCommand;
    MenuID       menuID;
    MenuItemIndex menuItem;

    eventClass = GetEventClass(eventRef);
    eventKind  = GetEventKind(eventRef);

```

```

switch(eventClass)
{
    case kEventClassApplication:
        if(eventKind == kEventAppActivated)
        {
            if(gNotificationInQueue)
                doDisplayMessageToUser();
            result = noErr;
        }
        break;

    case kEventClassCommand:
        if(eventKind == kEventProcessCommand)
        {
            GetEventParameter(eventRef,kEventParamDirectObject,typeHICCommand,NULL,
                             sizeof(HICCommand),NULL,&hiCommand);
            menuID = GetMenuID(hiCommand.menu.menuRef);
            menuItem = hiCommand.menu.menuItemIndex;
            if((hiCommand.commandID != kHICCommandQuit) &&
               (menuID >= mAppleApplication && menuID <= mDemonstration))
            {
                doMenuChoice(menuID,menuItem);
                result = noErr;
            }
        }
        break;
}

return result;
}

// ***** windowEventHandler

OSStatus windowEventHandler(EventHandlerCallRef eventHandlerCallRef,EventRef eventRef,
                           void* userData)
{
    OSStatus result = eventNotHandledErr;
    UInt32 eventClass;
    UInt32 eventKind;
    WindowRef windowRef;
    SInt32 deviceLoopUserData;
    RgnHandle regionHdl;
    Rect portRect, positioningBounds;
    Point idealHeightAndWidth, minimumHeightAndWidth;

    eventClass = GetEventClass(eventRef);
    eventKind = GetEventKind(eventRef);

    switch(eventClass)
    {
        case kEventClassWindow:
            GetEventParameter(eventRef,kEventParamDirectObject,typeWindowRef,NULL,sizeof(windowRef),
                             NULL,&windowRef);

```

```

switch(eventKind)
{
    case kEventWindowDrawContent:
        if(gMultiMonitorsDrawDemo)
        {
            RGBBackColor(&gWhiteColor);
            deviceLoopUserData = (SInt32) windowRef;
            regionHdl = NewRgn();
            if(regionHdl)
            {
                GetPortVisibleRegion(GetWindowPort(windowRef),regionHdl);
                DeviceLoop(regionHdl,gDeviceLoopDrawUPP,deviceLoopUserData,0);
                DisposeRgn(regionHdl);
            }
        }
        else if(gColorPickerDemo )
        {
            RGBBackColor(&gBlueColor);
            GetWindowPortBounds(windowRef,&portRect);
            EraseRect(&portRect);
            doDrawColorPickerChoice();
        }
        else
        {
            RGBBackColor(&gBlueColor);
            GetWindowPortBounds(windowRef,&portRect);
            EraseRect(&portRect);
            if(gHelpTagsDemo)
            {
                Draw1Control(gBevelButtonControlRef);
                RGBForeColor(&gWhiteColor);
                MoveTo(10,20);
                DrawString("\pHover the cursor in the window, and over the bevel button, ");
                DrawString("\puntil the Help tag appears.");
                MoveTo(10,35);
                DrawString("\pPress the Command key to invoke the maximum content.");
                MoveTo(10,50);
                DrawString("\pDrag the window to a new location.");
            }
        }
        result = noErr;
        break;

    case kEventWindowGetIdealSize:
        GetAvailableWindowPositioningBounds(GetMainDevice(),&positioningBounds);
        idealHeightAndWidth.v = positioningBounds.bottom;
        idealHeightAndWidth.h = positioningBounds.right;
        SetEventParameter(eventRef,kEventParamDimensions,typeQDPoint,
            sizeof(idealHeightAndWidth),&idealHeightAndWidth);
        result = noErr;
        break;

```

```

    case kEventWindowGetMinimumSize:
        minimumHeightAndWidth.v = 302;
        minimumHeightAndWidth.h = 445;
        SetEventParameter(eventRef, kEventParamDimensions, typeQDPoint,
            sizeof(minimumHeightAndWidth), &minimumHeightAndWidth);

        result = noErr;
        break;

    case kEventWindowBoundsChanged:
        doHelpTagWindow();
        GetWindowPortBounds(windowRef, &portRect);
        InvalWindowRect(windowRef, &portRect);
        result = noErr;
        break;
}
break;
}

return result;
}

// ***** doMenuChoice

void doMenuChoice(MenuID menuID, MenuItemIndex menuItem)
{
    Rect portRect;

    if(menuID == 0)
        return;

    switch(menuID)
    {
        case mAppleApplication:
            if(menuItem == iAbout)
                SysBeep(10);
            break;

        case mDemonstration:
            gMultiMonitorsDrawDemo = gColorPickerDemo = gHelpTagsDemo = false;
            if(HMAreHelpTagsDisplayed)
                HMSetHelpTagsDisplayed(false);
            HideControl(gBevelButtonControlRef);
            GetWindowPortBounds(gWindowRef, &portRect);

            switch(menuItem)
            {
                case iNotification:
                    RGBBackColor(&gBlueColor);
                    EraseRect(&portRect);
                    doSetUpNotification();
                    break;
            }
        }
    }
}

```

```

        case iProgress:
            RGBBackColor(&gBlueColor);
            EraseRect(&portRect);
            doProgressBar();
            break;

        case iColorPicker:
            gColorPickerDemo = true;
            doColorPicker();
            break;

        case iMultiMonitors:
            gMultiMonitorsDrawDemo = true;
            InvalWindowRect(gWindowRef,&portRect);
            break;

        case iHelpTag:
            gHelpTagsDemo = true;
            InvalWindowRect(gWindowRef,&portRect);
            ShowControl(gBevelButtonControlRef);
            HMSetHelpTagsDisplayed(true);
            break;
    }

    break;
}
}

// *****
// Notification.c
// *****

#include "Miscellany.h"

// ..... global variables

NMRec          gNotificationStructure;
long           gStartingTickCount;
Boolean        gNotificationDemoInvoked;
Boolean        gNotificationInQueue;
extern WindowRef gWindowRef;
extern ProcessSerialNumber gProcessSerNum;
extern RGBColor gWhiteColor;
extern RGBColor gBlueColor;

// ***** doSetUpNotification

void doSetUpNotification(void)
{
    doPrepareNotificationStructure();
    gNotificationDemoInvoked = true;

    gStartingTickCount = TickCount();

```

```

    RGBForeColor(&gWhiteColor);
    MoveTo(10,279);
    DrawString("\pPlease click on the desktop now to make the Finder ");
    DrawString("\pthe frontmost application.");
    MoveTo(10,292);
    DrawString("\p(This application will post a notification 10 seconds from now.)");
}

// ***** doPrepareNotificationStructure

void doPrepareNotificationStructure(void)
{
    Handle      iconSuiteHdl;
    Handle      soundHdl;
    StringHandle stringHdl;

    GetIconSuite(&iconSuiteHdl,rIconFamily,kSelectorAllSmallData);
    soundHdl = GetResource('snd ',rBarkSound);
    stringHdl = GetString(rString);

    gNotificationStructure.qType      = nmType;
    gNotificationStructure.nmMark     = 1;
    gNotificationStructure.nmIcon     = iconSuiteHdl;
    gNotificationStructure.nmSound    = soundHdl;
    gNotificationStructure.nmStr      = *stringHdl;
    gNotificationStructure.nmResp     = NULL;
    gNotificationStructure.nmRefCon    = 0;
}

// ***** doIdle

void doIdle(void)
{
    ProcessSerialNumber frontProcessSerNum;
    Boolean              isSameProcess;
    Rect                 portRect;

    if(gNotificationDemoInvoked)
    {
        if(TickCount() > gStartingTickCount + 600)
        {
            GetFrontProcess(&frontProcessSerNum);
            SameProcess(&frontProcessSerNum,&gProcessSerNum,&isSameProcess);

            if(!isSameProcess)
            {
                NMInstall(&gNotificationStructure);
                gNotificationDemoInvoked = false;
                gNotificationInQueue = true;
            }
            else
            {
                doDisplayMessageToUser();
                gNotificationDemoInvoked = false;
            }
        }
    }
}

```

```

        GetWindowPortBounds(gWindowRef,&portRect);
        EraseRect(&portRect);
    }
}

// ***** doDisplayMessageToUser

void doDisplayMessageToUser(void)
{
    Rect                portRect;
    AlertStdAlertParamRec paramRec;
    Str255              labelText;
    Str255              narrativeText;
    SInt16              itemHit;

    if(gNotificationInQueue)
    {
        NMRemove(&gNotificationStructure);
        gNotificationInQueue = false;
    }

    GetWindowPortBounds(gWindowRef,&portRect);
    EraseRect(&portRect);

    paramRec.movable      = true;
    paramRec.helpButton   = false;
    paramRec.filterProc   = NULL;
    paramRec.defaultText  = (StringPtr) kAlertDefaultOKText;
    paramRec.cancelText   = NULL;
    paramRec.otherText    = NULL;
    paramRec.defaultButton = kAlertStdAlertOKButton;
    paramRec.cancelButton = 0;
    paramRec.position     = kWindowDefaultPosition;

    GetIndString(labelText,rAlertStrings,indexLabel);
    GetIndString(narrativeText,rAlertStrings,indexNarrative);

    StandardAlert(kAlertNoteAlert,labelText,narrativeText,&paramRec,&itemHit);

    DisposeIconSuite(gNotificationStructure.nmIcon,false);
    ReleaseResource(gNotificationStructure.nmSound);
    ReleaseResource((Handle) gNotificationStructure.nmStr);
}

// *****
// ProgressIndicator.c
// *****

#include "Miscellany.h"

// ..... global variables

extern WindowRef gWindowRef;
extern RGBColor  gWhiteColor;

```

```
// ***** doProgressBar
```

```
void doProgressBar(void)
{
    DialogRef dialogRef;
    RgnHandle visRegionHdl = NewRgn();
    ControlRef progressBarRef;
    SInt16 statusMax, statusCurrent;
    SInt16 a, b, c;
    Handle soundHdl;
    Rect portRect, theRect;
    RGBColor redColor = { 0xFFFF, 0x0000, 0x0000 };

    if(!(dialogRef = GetNewDialog(rDialog,NULL,(WindowRef) -1)))
        ExitToShell();

    SetPortDialogPort(dialogRef);
    GetPortVisibleRegion(GetWindowPort(GetDialogWindow(dialogRef)),visRegionHdl);
    UpdateControls(GetDialogWindow(dialogRef),visRegionHdl);
    QDFlushPortBuffer(GetDialogPort(dialogRef),NULL);

    SetPortWindowPort(gWindowRef);
    GetWindowPortBounds(gWindowRef,&portRect);

    GetDialogItemAsControl(dialogRef,iProgressIndicator,&progressBarRef);

    statusMax = 3456;
    statusCurrent = 0;
    SetControlMaximum(progressBarRef,statusMax);

    for(a=0;a<9;a++)
    {
        for(b=8;b<423;b+=18)
        {
            for(c=8;c<286;c+=18)
            {
                if(CheckEventQueueForUserCancel())
                {
                    soundHdl = GetResource('snd ',rBarkSound);
                    SndPlay(NULL,(SndListHandle) soundHdl,false);
                    ReleaseResource(soundHdl);
                    DisposeDialog(dialogRef);

                    EraseRect(&portRect);
                    MoveTo(10,292);
                    RGBForeColor(&gWhiteColor);
                    DrawString("\pOperation cancelled at user request");

                    return;
                }

                SetRect(&theRect,b+a,c+a,b+17-a,c+17-a);
                if(a < 3) RGBForeColor(&gWhiteColor);
                else if(a > 2 && a < 6) RGBForeColor(&redColor);
                else if(a > 5) RGBForeColor(&gWhiteColor);
                FrameRect(&theRect);
            }
        }
    }
}
```



```

        QDFlushPortBuffer(GetWindowPort(gWindowRef),NULL);
        QDFlushPortBuffer(GetDialogPort(dialogRef),NULL);

        SetControlValue(progressBarRef,statusCurrent++);
    }
}

DisposeRgn(visRegionHdl);
DisposeDialog(dialogRef);
EraseRect(&portRect);
MoveTo(10,292);
RGBForeColor(&gWhiteColor);
DrawString("\pOperation completed");
}

// *****
// ColorPicker.c
// *****

#include "Miscellany.h"

// ..... global variables

RGBColor      gInColor = { 0xCCCC, 0x0000, 0x0000 };
RGBColor      gOutColor;
Boolean       gColorPickerButton;
extern WindowRef gWindowRef;
extern RGBColor gWhiteColor;
extern RGBColor gBlueColor;

// ***** doColorPicker

void doColorPicker(void)
{
    Rect portRect, theRect;
    Point where;
    Str255 prompt = "\pChoose a rectangle color:";

    GetWindowPortBounds(gWindowRef,&portRect);
    theRect = portRect;

    RGBBackColor(&gBlueColor);
    EraseRect(&theRect);
    InsetRect(&theRect,55,55);
    RGBForeColor(&gInColor);
    PaintRect(&theRect);

    where.v = where.h = 0;

    gColorPickerButton = GetColor(where,prompt,&gInColor,&gOutColor);

```

```

    InvalWindowRect(gWindowRef,&portRect);
}

// ***** doDrawColorPickerChoice

void doDrawColorPickerChoice(void)
{
    Rect portRect;
    char *cString;

    GetWindowPortBounds(gWindowRef,&portRect);
    InsetRect(&portRect,55,55);

    if(gColorPickerButton)
    {
        RGBForeColor(&gOutColor);
        PaintRect(&portRect);

        RGBForeColor(&gWhiteColor);

        MoveTo(55,22);
        DrawString("\pRequested Red Value: ");
        cString = doDecimalToHexadecimal(gOutColor.red);
        MoveTo(170,22);
        DrawText(cString,0,6);

        MoveTo(55,35);
        DrawString("\pRequested Green Value: ");
        cString = doDecimalToHexadecimal(gOutColor.green);
        MoveTo(170,35);
        DrawText(cString,0,6);

        MoveTo(55,48);
        DrawString("\pRequested Blue Value: ");
        cString = doDecimalToHexadecimal(gOutColor.blue);
        MoveTo(170,48);
        DrawText(cString,0,6);
    }
    else
    {
        RGBForeColor(&gInColor);
        PaintRect(&portRect);

        RGBForeColor(&gWhiteColor);
        MoveTo(55,48);
        DrawString("\pCancel button was clicked.");
    }
}

```

```
// ***** doDecimalToHexadecimal

char *doDecimalToHexadecimal(UInt16 decimalNumber)
{
    static char cString[] = "0XXXX";
    char *hexCharas = "0123456789ABCDEF";
    SInt16 a;

    for (a=0;a<4;decimalNumber >>= 4,++a)
        cString[5 - a] = hexCharas[decimalNumber & 0xF];

    return cString;
}

// *****
// MultiMonitor.c
// *****

#include "Miscellany.h"

// ***** deviceLoopDraw

void deviceLoopDraw(SInt16 depth,SInt16 deviceFlags,GDHandle targetDeviceHdl,SInt32 userData)
{
    RGBColor oldForeColor;
    WindowRef windowRef;
    Rect portRect;
    RGBColor greenColor = { 0x0000, 0xAAAA, 0x1111 };
    RGBColor redColor = { 0xAAAA, 0x4444, 0x3333 };
    RGBColor blueColor = { 0x5555, 0x4444, 0xFFFF };
    RGBColor ltGrayColor = { 0xDDDD, 0xDDDD, 0xDDDD };
    RGBColor grayColor = { 0x9999, 0x9999, 0x9999 };
    RGBColor dkGrayColor = { 0x4444, 0x4444, 0x4444 };

    GetForeColor(&oldForeColor);

    windowRef = (WindowRef) userData;
    GetWindowPortBounds(windowRef,&portRect);
    EraseRect(&portRect);

    if(((1 << gdDevType) & deviceFlags) != 0)
    {
        InsetRect(&portRect,50,50);
        RGBForeColor(&greenColor);
        PaintRect(&portRect);
        InsetRect(&portRect,40,40);
        RGBForeColor(&redColor);
        PaintRect(&portRect);
        InsetRect(&portRect,40,40);
        RGBForeColor(&blueColor);
        PaintRect(&portRect);
    }
    else

```

```

{
    InsetRect(&portRect,50,50);
    RGBForeColor(&ltGrayColor);
    PaintRect(&portRect);
    InsetRect(&portRect,40,40);
    RGBForeColor(&grayColor);
    PaintRect(&portRect);
    InsetRect(&portRect,40,40);
    RGBForeColor(&dkGrayColor);
    PaintRect(&portRect);
}

RGBForeColor(&oldForeColor);
}

// *****
// HelpTag.c
// *****

#include "Miscellany.h"
#include <string.h>

// ..... global variables

extern ControlRef gBevelButtonControlRef;
extern WindowRef  gWindowRef;

// ..... doHelpTagControl

void doHelpTagControl(void)
{
    HMHelpContentRec helpContent;

    memset(&helpContent,0,sizeof(helpContent));
    HMSetTagDelay(50);

    helpContent.version = kMacHelpVersion;
    helpContent.tagSide = kHMOoutsideBottomLeftAligned;

    helpContent.content[kHMMMinimumContentIndex].contentType = kHMStringResContent;
    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmResID = 129;
    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 1;
    helpContent.content[kHMMMaximumContentIndex].contentType = kHMStringResContent;
    helpContent.content[kHMMMaximumContentIndex].u.tagStringRes.hmmResID = 129;
    helpContent.content[kHMMMaximumContentIndex].u.tagStringRes.hmmIndex = 2;

    HMSetControlHelpContent(gBevelButtonControlRef,&helpContent);
}

```

```
// ..... doHelpTagWindow

void doHelpTagWindow(void)
{
    Rect          hotRect;
    HMHelpContentRec helpContent;

    memset(&helpContent,0,sizeof(helpContent));
    HMSetTagDelay(500);

    helpContent.version = kMacHelpVersion;
    helpContent.tagSide = kHMOutsideRightCenterAligned;

    GetWindowPortBounds(gWindowRef,&hotRect);
    LocalToGlobal(&topLeft(hotRect));
    LocalToGlobal(&botRight(hotRect));
    helpContent.absHotRect = hotRect;

    helpContent.content[kHMMMinimumContentIndex].contentType = kHMStringResContent;
    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmResID = 129;
    helpContent.content[kHMMMinimumContentIndex].u.tagStringRes.hmmIndex = 3;
    helpContent.content[kHMMMaximumContentIndex].contentType = kHMStringResContent;
    helpContent.content[kHMMMaximumContentIndex].u.tagStringRes.hmmResID = 129;
    helpContent.content[kHMMMaximumContentIndex].u.tagStringRes.hmmIndex = 4;

    HMSetWindowHelpContent(gWindowRef,&helpContent);
}

// *****
```

## Demonstration Program Miscellany Comments

When this program is run, the user should make choices from the Demonstration menu, taking the following actions and making the following observations:

- Choose the Notification item and, observing the instructions in the window, click the desktop immediately to make the Finder the foreground application. A notification will be posted by Miscellany about 10 seconds after the Notification item choice is made. When about 10 seconds have elapsed, the Notification Manager invokes an alert (Mac OS 8.6), floating window (Mac OS 9.x), or system movable modal alert (Mac OS X) and alternates the Finder and Miscellany icons in the OS 8/9 Application menu title. Observing the instructions in the alert/floating window/system movable modal alert:
  - Dismiss the alert (Mac OS 8.6 only).
  - On Mac OS 8/9, then choose the Miscellany item in the OS 8/9 Application menu, noting the ♦ mark to the left of the item name. When Miscellany comes to the foreground, note that the icon alternation concludes and that an alert (invoked by Miscellany) appears. Dismiss this second alert.
  - On Mac OS X, click on the application's icon in the Dock.

- Choose the Notification item again and this time leave Miscellany in the foreground. Note that only the alert invoked by Miscellany appears on this occasion.
- Choose the Notification item again and, this time, click on the desktop and then in the Miscellany window before 10 seconds elapse. Note again that only the alert invoked by Miscellany appears.
- Choose the Determinate Progress Indicator item, noting that the progress indicator dialog is automatically disposed of when the (simulated) time-consuming task concludes.
- Choose the Determinate Progress Indicator item again, and this time press the Command-period key combination before the (simulated) time-consuming task concludes. Note that the progress indicator dialog is disposed of when the Command-period key combination is pressed.
- Choose the Color Picker item and make color choices using the various available modes. Note that, when the Color Picker is dismissed by clicking the OK button, the requested RGB color values for the chosen color are displayed in hexadecimal, together with a rectangle in that color, in the Miscellany window.
- Choose the Multiple Monitors Draw item, noting that the drawing of the simple demonstration image is optimised as follows:
  - On a monitor set to display 256 or more colors, the image is drawn in three distinct colors. The luminance of the three colors is identical, meaning that, if these colors are drawn on a grayscale screen, they will all appear in the same shade of gray.
  - On a monitor set to display 256 shades of gray, the image is drawn in three distinct shades of gray.
- Choose the Help Tags item, hover the cursor over the window, and when the Help tag appears, press the Command key to observe the maximum content version of the tag. Repeat this while hovering the cursor over the bevel button control.

## Miscellany.c

### Global Variables

`gDeviceLoopDrawUPP` will be assigned a universal procedure pointer to the image-optimizing drawing function `deviceLoopDraw` called by `DeviceLoop`. `gProcessSerNum` will be assigned the process serial number of the Miscellany application.

### main

The call to `NewDeviceLoopDrawingProc` creates a universal procedure pointer to the image-optimizing drawing function `deviceLoopDraw`.

A timer is installed and set to fire every one second. When it fires, the function `doIdle` is called.

A bevel button control is created, following which the calls to `doHelpTagControl` and `doHelpTagWindow` create Help tags for the bevel button control and the window. `HMSetHelpTagsDisplayed` is called to disable the tags until the Help Tags item is chosen from the Demonstration menu.

`GetCurrentProcess` gets the process serial number of this process. The timer and the process serial number are used in the notification demonstration.

### **appEventHandler**

When the `kEventAppActivated` event type is received, if the global variable `gNotificationInQueue` is set to true, `doDisplayMessageToUser` is called. This is part of the notification demonstration.

### **windowEventHandler**

When the `kEventWindowDrawContent` event type is received, if the Multiple Monitors Draw item in the Demonstration menu has been chosen (`gMultiMonitorsDrawDemo` is true), a call is made to `DeviceLoop` and the universal procedure pointer to the application-defined (callback) drawing function `deviceLoopDraw` is passed as the second parameter.

### **doMenuChoice**

When the Multiple Monitors Draw item in the Demonstration menu is chosen, the window's port rectangle is invalidated so as to force a `kEventWindowDrawContent` event and consequential call to `DeviceLoop`.

## **Notification.c**

### **doSetUpNotification**

`doSetUpNotification` is called when the user chooses Notification from the Demonstration menu.

The first line calls `doPrepareNotificationStructure`, which fills in the relevant fields of a notification structure. The next line assigns true to a global variable which records that the Notification item has been chosen by the user.

The next line saves the system tick count at the time that the user chose the Notification item. This value is used later to determine when 10 seconds have elapsed following the execution of this line.

### **doPrepareNotificationStructure**

`doPrepareNotificationStructure` fills in the relevant fields of the notification structure.

First, however, `GetIconSuite` creates an icon suite based on the specified resource ID and the third parameter, which limits the suite to 'ics#', 'ics4' and 'ics8' icons. The `GetIconSuite` call returns the handle to the suite in its first parameter. The call to `GetResource` loads the specified 'snd' resource. `GetString` loads the specified 'STR' resource.

The first line of the main block specifies the type of operating system queue. The next line specifies that the ♦ mark is to appear next to the application's name in the Mac OS 8/9 Application menu. The next three lines assign the icon suite (for Mac OS 8/9), sound (for Mac OS 8/9) and string handles previously obtained. The next line specifies that no response function is required to be executed when the notification is posted.

### **doIdle**

`doIdle` is called when the installed timer fires.

If the user has not just chosen the Notification item in the Demonstration menu (`gNotificationDemoInvoked` is false), `doIdle` simply returns immediately.

If, however, that item has just been chosen, and if 10 seconds (600 ticks) have elapsed since that choice was made, the following occurs:

- The calls to `GetFrontProcess` and `SameProcess` determine whether the current foreground process is Miscellany. If it is not, the notification request is installed in the notification queue by `NMInstall` and the global variable `gNotificationInQueue` is set to indicate that a request has been placed in the queue by Miscellany. (This latter causes `doDisplayMessageToUser` to be called when the `kEventAppActivated` event is received. `doDisplayMessageToUser` removes the notification request from the queue and has Miscellany convey the required message to the user.) Also, `gNotificationDemoInvoked` is set to false so as to ensure that the main if block only executes once after the Notification item is chosen.
- If, however, the current foreground process is Miscellany, the function `doDisplayMessageToUser` is called to present the required message to the user in the normal way. Once again `gNotificationDemoInvoked` is reset to false so as to ensure that the main if block only executes once after the Notification item is chosen.

### **doDisplayMessageToUser**

`doDisplayMessageToUser` is called by `appEventHandler` and `doIdle` in the circumstances previously described.

If a Miscellany notification request is in the queue, `NMRemove` removes it from the queue and `gNotificationInQueue` is set to false to reflect this condition. (Recall that, if the `nmResp` field of the notification structure is not assigned -1, the application itself must remove the queue element from the queue.)



Regardless of whether there was a notification in the queue or not, `Miscellany` then presents its alert. When the alert is dismissed, the notification's icon suite, sound and string resources are released/disposed of.

## ProgressBar.c

### **doProgressBar**

`doProgressBar` is called when the user chooses `Determinate Progress Indicator` from the `Demonstration` menu.

`GetNewDialog` creates a modal dialog. The call to `GetDialogItemAsControl` retrieves the dialog's progress indicator control. `SetControlMaximum` sets the control's maximum value to equate to the number of steps in a simulated time-consuming task.

The main for loop performs the simulated time-consuming task, represented to the user by the drawing of a large number of colored rectangles in the window. The task involves 3456 calls to `FrameRect`.

Within the inner for loop, `CheckEventQueueForCancel` is called to check whether the user has pressed the `Command-period` key. If so, a 'snd ' resource is loaded, played, and released, the dialog is disposed of, an advisory message is drawn in the window, and the function returns.

Each time around the inner for loop, a progress indicator control's value is incremented.

When the outer for loop exits (that is, when the `Command-period` key combination is not pressed before the simulated time-consuming task completes), the dialog is disposed of.

## ColorPicker.c

(f)`doColorPicker` is called when the user chooses `Color Picker` from the `Demonstration` menu.

The first block erases the window's content area and paints a rectangle in the color that will be passed in `GetColor`'s `inColor` parameter.

The next line assigns 0 to the fields of the `Point` variable to be passed in `GetColor`'s `where` parameter. ((0,0) will cause the `Color Picker` dialog to be centered on the main screen.)

The call to `GetColor` displays the `Color Picker`'s dialog. `GetColor` retains control until the user clicks either the `OK` button or the `Cancel` button, at which time the port rectangle is invalidated, causing the function `doDrawColorPickerChoice` to be called.

### **doDrawColorPickerChoice**

If the user clicked the `OK` button, a filled rectangle is painted in the window in the color returned in `GetColor`'s `outColor` parameter, and the values representing the red, green, and blue components of this color are displayed at the top of the window in hexadecimal. Note that the function `doDecimalToHexadecimal` is called to convert the decimal (`UInt32`) values in the fields of the `RGBColor` variable `outColor` to hexadecimal.

If the user clicks the Cancel button, a filled rectangle is painted in the window in the color passed in `GetColor`'s `inColor` parameter.

### **doDecimalToHexadecimal**

`doDecimalToHexadecimal` converts a `UInt16` value to a hexadecimal string.

## **MultiMonitor.c**

### **deviceLoopDraw**

`deviceLoopDraw` is the image-optimizing drawing function the universal procedure pointer to which is passed in the second parameter in the `DeviceLoop` call. (Recall that the `DeviceLoop` call is made whenever the Multiple Monitors Draw item in the Demonstration menu has been selected and an `kEventDrawContent` event type is received.) `DeviceLoop` scans all active video devices, calling `deviceLoopDraw` whenever it encounters a device that intersects the drawing region, and passing certain information to `deviceLoopDraw`.

The second line casts the `SInt32` value received in the `userData` parameter to a `WindowRef`. The window's content area is then erased.

If an examination of the device's attributes, as received in the `deviceFlags` formal parameter, reveals that the device is a color device, three rectangles are painted in the window in three different colors. (The luminance value of these colors is the same, meaning that the rectangles would all be the same shade of gray if they were drawn on a monochrome (grayscale) device.)

If the examination of the device's attributes reveals that the device is a monochrome device, the rectangles are painted in three distinct shades of gray.

## **HelpTag.c**

### **doHelpTagControl and doHelpTagWindow**

`doHelpTagControl` and `doHelpTagWindow` create Help tags for the bevel button control and the window.

The call to `memset` clears the specified block of memory. The call to `HMSetTagDelay` sets the delay, in milliseconds, before the tag opens.

For the bevel button, the `tagSide` field of the `HMHelpContentRec` structure is assigned a value which will cause the control's tag to be displayed below the control with its left side aligned with the left side of the button. For the window, the `tagSide` field is assigned a value that will cause the control's tag to be displayed on the window's right, centered vertically.

The main block sets the content type and retrieves and assigns the minimum and maximum content strings from a 'STR#' resource. The calls to `HMSetControlHelpContent` and `HMSetWindowHelpContent` install the Help tags on the control and window.



# More on Text—Multilingual Text Engine

CHAPTER

26

## IN THIS CHAPTER

- Introduction 1442
- Working with MLTE 1444
- Main Constants, Data Types, and Functions 1455
- Demonstration Program MLTETextEditor Listing 1461
- Demonstration Program MLTETextEditor Comments 1500

## Introduction

The Multilingual Text Engine (MLTE), which was introduced with Mac OS 9.0 as an alternative for TextEdit, profoundly simplified the task of handling multistyled text and provided many new features not provided by TextEdit. The main additional features are as follows:

- Documents can be larger than 32KB (the TextEdit limit).
- Tabs.
- Text justification.
- Ability to embed movie, sound, and graphics objects in documents.
- Built-in support for
  - Scroll bar creation and handling, including live scrolling and proportional scroll boxes.
  - Undo/redo (32 levels).
  - Printing.
  - Drag and drop.
  - The public clipboard, specifically, copying and pasting:
    - Plain text.
    - Plain text with style resources.
    - Unicode text.
    - Flattened Unicode style information.
    - Movies, graphics, and sound.
    - In-line input.

MLTE uses Apple Type Services for Unicode Imaging (**ATSUI**) to measure and draw text. ATSUI, which was introduced with Mac OS 8.6, replaced QuickDraw and the Script Manager as the low-level means of imaging and measuring text.

MLTE renders text into a rectangular frame. Applications can specify that lines be arbitrarily wide or auto-wrapped.

## Global Layout Settings

The following are the main settings applying to the whole document:

- Justification, which can be default, left, right, center, full, or forced full.
- Tab values.
- Margins.

- Auto-indent on or off.
- Text auto-wrap on or off.
- Read-only status on or off.
- Line direction.

## Undoable and Redoable Actions

The following actions are undoable and redoable:

- Typing.
- Cut, paste, and clear.
- Change font, and font size, style, and color.
- Justification.
- Drag-and-drop move and copy.

## Selection Behavior

Within an MLTE document, a single-click defines an insertion point. (Recall from Chapter 21 that an insertion point is, in effect, a selection containing zero characters.) A double-click selects a word, and a triple-click selects a line.

## File Types

MLTE supports saving and opening files of the following types:

- A new type introduced with MLTE called Textension ('txtn'). This should be the preferred type for media-rich documents that can contain movies, graphics, and sound.
- Text ('TEXT'), with or without style information. Style information may be saved as either 'styl' resources or 'MPSR' resources. If 'styl' resources are used, documents can have text in an unlimited number of styles; however, tabs will not be saved. If 'MPSR' resources are used, only the first style in the document will be saved.

### NOTE

For example, SimpleText saves style information in 'styl' resources whereas Macintosh Programmer's Workshop (MPW), CodeWarrior and BBEdit save style information in MPW 'MPSR' resources.

- Plain Unicode text ('utxt').
- Movie ('MooV'), sound ('sfil' and 'AIFF'), and picture ('PICT').

## Working with MLTE

### Initializing and Terminating MLTE

TXNInitTextension should be called at program start to initialise the Textension library:

```
OSStatus TXNInitTextension(const TXNMacOSPreferredFontDescription iDefaultFonts[],
                          ItemCount iDefaultFonts, TXNInitOptions iUsageFlags);
```

iDefaultFonts NULL, or a table of entries for any encoding for which it is desired to designate a default font:

```
struct TXNMacOSPreferredFontDescription
{
    UInt32      fontID;      // Can assign kTXNDefaultFontName
    Fixed       pointSize;   // Can assign kTXNDefaultFontSize
    TextEncoding encoding;
    Style       fontStyle;   // Can assign kTXNDefaultFontStyle
};
```

For the encoding field, relevant constants are

```
kTXNSystemDefaultEncoding
kTXNMacOSEncoding
kTXNUnicodeEncoding
```

kTXNSystemDefaultEncoding the encoding preferred by MLTE and the system. This is Unicode if ATSUI is present, as it will be on Mac OS 8.6 and later.)

iDefaultFonts Number of default fonts designated.

IUsageFlags Specifies whether movies, sound, and/or graphics should be supported.

Relevant constants are:

```
kTXNWantMoviesMask
kTXNWantSoundMask
kTXNWantGraphicsMask
```

At program termination, you should call TXNTerminateTextension to close the Textension library and perform other clean-up actions.

### Allocating and Deleting a TXNObject

Ordinarily, to create a new document, you create a new window and then pass a reference to that window in a call to TXNNewObject. TXNNewObject creates a new TXNObject, an object that contains private variables and functions required to handle text formatting:

```

OSStatus  TXNNewObject(const FSSpec *      iFileSpec,          // Can be NULL
                      WindowRef           iWindow,
                      Rect *               iFrame,              // Can be NULL
                      TXNFrameOptions     iFrameOptions,
                      TXNFrameType         iFrameType,
                      TXNFileType          iFileType,
                      TXNPermanentTextEncodingType iPermanentEncoding,
                      TXNObject *          oTXNObject,
                      TXNFrameID *         oTXNFrameID,
                      TXNObjectRefcon      iRefCon);

```

**iFileSpec** Pointer to file system specification structure. The file is read in, and its contents displayed, after the **TXNObject** is allocated. If **NULL** is passed in this parameter, the document will be empty at start.

**iWindow** Reference to the window to be attached to the **TXNObject**, and in which the document will be displayed.

**iFrame** The area of the window in which the document's contents are to be displayed. Passing **NULL** in this parameter sets the frame to equate to the window's port rectangle.

**iFrameOptions** The options supported by this frame. The principal relevant constants are

```

kTXNShowWindowMask    Show window before TXNNewObject returns.
kTXNWantHScrollBarMask Include horizontal scroll bar.
kTXNWantVScrollBarMask Include vertical scroll bar.
kTXNNoSelectionMask    Do not display insertion point.

```

**iFrameType** The frame type. Relevant constants are

```

kTXNTextEditStyleFrameType
kTXNPageFrameType
kTXNMultipleFrameType

```

**iFileType** The primary file type. The principal relevant constants are:

```

kTXNTextensionFile
kTXNTextFile
kTXNUnicodeTextFile

```

If you specify **kTXNTextFile**, and want style information to be saved, you can specify whether that information should be saved in a 'styl' resource or an 'MPSR' resource when calling the function **TXNSave** (see below).



`iPermanentEncoding` The encoding the application considers text to be in. Relevant constants are

`kTXNSystemDefaultEncoding` Encoding preferred by MLTE and the system. (This is Unicode if ATSUI is present.)

`kTXNMacOSEncoding` Incoming and outgoing text to be in traditional MacOS encoding.

`kTXNUnicodeEncoding` Incoming and outgoing text to be in Unicode, even on systems that do not have ATSUI.

`OTXNObject` On output, a pointer to a `TXNObject`.

`OTXNFrameID` On output, a unique ID for the frame.

`IRefCon` Reference constant for use by the application.

If `TXNNewObject` is called with `NULL` passed in the `iWindow` parameter, a window can later be attached to the `TXNObject` by a call to the function `TXNAttachObjectToWindow`.

A previously allocated `TXNObject` and its associated data structures may be deleted by a call to the function `TXNDeleteObject`.

## Setting and Getting Global Layout Settings

As previously stated, certain layout settings (for example, justification, tabs, and margins) apply to the whole `TXNObject`, that is, the whole document. These layout settings are referred to as **control information**. You can set control information by calling

`TXNSetTXNObjectControls`:

```
OSStatus TXNSetTXNObjectControls(TXNObject iTXNObject,
                                  Boolean iClearAll,
                                  ItemCount iControlCount,
                                  TXNControlTag iControlTags[],
                                  TXNControlData iControlData[]);
```

`IClearAll` Pass true to reset all controls to the default.

`IControlCount` The number of elements in the `iControlTags` and `iControlData` arrays, that is, the number of settings being changed.

`IControlTags` An array of type `TXNControlTag` containing control tags. The principal relevant tags are:

`kTXNJustificationTag`

`kTXNTabSettingsTag`

`kTXNMarginsTag`

`kTXNWordWrapStateTag`

**iControlData** An array of **TXNControlData** structures containing the control information being set. The **TXNControlData** structure, and its associated structures, are as follows:

```

union TXNControlData
{
    UInt32      uValue;
    SInt32      sValue;
    TXNTab      tabValue;
    TXNMargins * marginsPtr;
};

typedef union TXNControlData;

struct TXNTab
{
    SInt16      value;
    TXNTabType  tabType;
    UInt8       filler;
};

typedef struct TXNTab TXNTab;

struct TXNMargins
{
    SInt16 topMargin;
    SInt16 leftMargin;
    SInt16 bottomMargin;
    SInt16 rightMargin;
};

typedef struct TXNMargins TXNMargins;

```

Constants relevant to the `uValue` field when setting justification are

```
kTXNFlushDefault
kTXNFlushLeft
kTXNFlushRight
kTXNCenter
kTXNFullJust
kTXNForceFullJust
```

Constants relevant to the `tabType` field when setting tabs are

```
kTXNRightTab
kTXNLeftTab
kTXNCenterTab
```

Constants relevant to the `uValue` field when setting word wrapping are

kTXNAutoWrap  
kTXNNoAutoWrap

You can get control information by calling `TXNGetTXNObjectControls`:

[illegible]

**IControlCount** The number of elements in the `iControlTags` and `iControlData` arrays.

**IControlTags** An array of type `TXNControlTag` containing control tags.

**OControlData** An array of `TXNControlData` structures containing, on output, the control information requested by the tags in the `iControlTags` array.

## Setting the Background

You can set the background by calling `TXNSetBackground`:

```
OSStatus TXNSetBackground(TXNObject iTXNObject, TXNBackground * iBackgroundInfo);
```

**iBackgroundInfo** A pointer to a `TXNBackground` structure that describes the background. The `TXNBackground` structure and its associated union are as follows:

```
struct TXNBackground
{
    TXNBackgroundType bgType; // Assign kTXNBackgroundTypeRGB
    TXNBackgroundData bg;
};
typedef struct TXNBackground TXNBackground;

union TXNBackgroundData
{
    RGBColor color;
};
typedef union TXNBackgroundData TXNBackgroundData;
```

The only background type available with Version 1.1 of MLTE is a color. `TXNBackgroundData` is a union so that it can be expanded in the future to support other background types, such as pictures.

## Setting and Getting Type Attributes

You can set type attributes such as text size, style, and color by calling `TXNSetTypeAttributes`:

```
OSStatus TXNSetTypeAttributes(TXNObject iTXNObject,
                               ItemCount iAttrCount,
                               TXNTypeAttributes iAttributes[],
                               TXNOffset iStartOffset,
                               TXNOffset iEndOffset);
```

**iAttrCount** The number of elements in the `iAttributes` array, that is, the number of attributes being set.

**iAttributes** An array of `TXNTypeAttributes` structures specifying the attribute being set and the data, or pointer to the data, that will set the attribute. Values less than or equal to `sizeof(UInt32)` are passed by value. Values greater than `sizeof(UInt32)` are passed by pointer. The `TXNTypeAttributes` structure, and its main associated structure, are as follows:

```

struct TXNTypeAttributes
{
    TXNTTag          tag;
    ByteCount        size;
    TXNAttributeData data;
};
typedef struct TXNTypeAttributes TXNTypeAttributes;

union TXNAttributeData
{
    void *           dataPtr;
    UInt32           dataValue;
    TXNATSUIFeatures * atsuFeatures;
    TXNATSUIVariations * atsuVariations;
};
typedef union TXNAttributeData TXNAttributeData;

```

The principal constants relevant to the tag field are

```

kTXNQDFontSizeAttribute
kTXNQDFontStyleAttribute
kTXNQDFontColorAttribute

```

The associated constants relevant to the size field are

```

kTXNFontSizeAttributeSize
kTXNQDFontStyleAttributeSize
kTXNQDFontColorAttributeSize

```

**iStartOffset** The offset at which to begin setting the attributes. If the requirement is to apply the attributes to the current selection, pass `kTXNUseCurrentSelection` in this parameter.

**IEndOffset** The offset at which to end setting the attributes. This parameter is ignored if `kTXNUseCurrentSelection` is passed in the `iStartOffset` parameter.

When your application detects a mouse-down in the menu bar or a Command-key combination, it typically adjusts its menus, enabling and disabling menu items as appropriate. If your application contains menus that allow the user to set type attributes, it must also prepare those menus for display by checkmarking and un-checkmarking items as appropriate.

Using a Size menu as an example, if the current selection (whether it be an empty or non-empty selection) contains text that is all of a single size, the menu item corresponding to that size, and only that menu item, should be checkmarked before the menu is displayed. However, if the selection contains text in two or more sizes, all menu items should be uncheckmarked. It is thus necessary to examine the selection to determine whether it contains a continuous size run or multiple sizes.

You can examine the current selection to determine whether font size, style, and color are continuous by calling `TXNGetContinuousTypeAttributes`:

```
OSStatus TXNGetContinuousTypeAttributes(TXNObject      iTxnObject,
                                         TXNContinuousFlags * oContinuousFlags,
                                         ItemCount      iCount,
                                         TXNTypeAttributes ioTypeAttributes[]);
```

**OContinuousFlags** On output, the relevant bit, or bits, of this parameter can be examined to determine whether the associated attribute, or attributes, is/are continuous. For example, if size is continuous, bit 1 will be set. The relevant constants are

```
kTXNSizeContinuousMask
kTXNStyleContinuousMask
kTXNColorContinuousMask
```

**iCount** Number of elements in the `ioTypeAttributes` array, that is, the number of attributes being examined.

**IoTypeAttributes** An array of `TXNTypeAttributes` structures (see above). On input, the `tag` field in each structure specifies the attribute to be examined. On output, if the attribute is continuous, the `dataValue` or `dataPtr` field of the `data` field will contain a value, or a pointer to data, which can be used to determine which menu item should be checkmarked.

## Functions Relevant to Events

The following functions are relevant to event handling:

<i>Function</i>	<i>Description</i>
<code>TXNClick</code>	Processes clicks in the content region, handling text selection, scrolling, drag and drop, and playing movies and sound.
<code>TXNUpdate</code>	Handles update events, redrawing the contents of the window. Calls <code>BeginUpdate</code> and <code>EndUpdate</code> .
<code>TXNForceUpdate</code>	Forces an update event to be generated, thus forcing the contents of the window to be redrawn.
<code>TXNDraw</code>	Similar to <code>TXNUpdate</code> , except that <code>BeginUpdate</code> and <code>EndUpdate</code> are not called. Should be used, in lieu of <code>TXNUpdate</code> , for a window that contains multiple <code>TXNObjects</code> or some graphic element.
<code>TXNActivate</code>	In MLTE, activation is a two-step process. <code>TXNActivate</code> performs the first step, which has to do with activating or deactivating the scroll bars.

<i>Function</i>	<i>Description</i>
	When true is passed in the <code>TXNScrollBarState</code> parameter, the scroll bars are activated, even when text input (selection and typing) has been defeated by <code>TXNFocus</code> (see below). When false is passed in the <code>TXNScrollBarState</code> parameter, the scroll bars are deactivated.
<code>TXNFocus</code>	The second step in the activation process has to do with activating text input (selection and typing).  When true is passed in the <code>iBecomingFocused</code> parameter, text input is activated. When false is passed in the <code>iBecomingFocused</code> parameter text input is deactivated.
<code>TXNAdjustCursor</code>	Handles cursor shape-changing. If the cursor is over a text area, it is set to the I-beam shape. If it is over a scrollbar, a movie, graphic, or a sound, or outside the frame, it is set to the arrow shape.  Not relevant in applications using the Carbon event model.
<code>TXNZoomWindow</code>	Handles mousedown in the zoom box.
<code>TXNGrowWindow</code>	Handles mouse-downs in the size box.
<code>TXNGetSleepTicks</code>	Gets the appropriate sleep time.

In Carbon applications, calling `TXNKeyDown` on receipt of key events is not necessary, since MLTE handles the event itself without any assistance on the part of your application. Note also that

- When the Classic event model is used, it is not possible to filter key events because the event is sent to MLTE before `WaitNextEvent` delivers it to your application.
- When the Carbon event model is used, key events are sent through the Carbon event system before they are sent to MLTE. This means that you can filter key events by installing a handler for the `kEventUnicodeForKeyEvent` event kind, for example (`kEventClassTextInput` event class).

## Functions Relevant to the File Menu

The following functions are relevant to your application's File menu:

<i>Function</i>	<i>Description</i>
<code>TXNSave</code>	Saves the contents of a document to a file of a specified file type (for example, Textension, text, or Unicode text). The data fork of the file must be open and its file reference number passed in the <code>iDataReference</code> parameter.

<i>Function</i>	<i>Description</i>
	For files of type text, if style information is also to be saved, the resource fork of the file must also be open and its file reference number passed in the <code>iResourceReference</code> parameter (The <code>iResourceReference</code> parameter is ignored when the Textension file type is specified.)
	<code>kTXNMultipleStylesPerTextDocumentResType</code> passed in the <code>iResType</code> parameter causes style information be saved to a 'style' resource. To specify that style information be saved to an 'MPSR' resource, pass <code>kTXNSingleStylePerTextDocumentResType</code> in the <code>iResType</code> parameter.
	<code>TXNSave</code> does not move the file mark before writing to a file. This allows you to write private data first (if required), followed by the data written by <code>TXNSave</code> .
<code>TXNRevert</code>	Reverts to the last saved version of the document or, if the document has never been saved, reverts to an empty document.
<code>TXNPageSetup</code>	Displays the Page Setup dialog and reformats the text if settings are changed by the user.
<code>TXNPrint</code>	Displays the Print dialog and prints the document.
<code>TXNGetChangeCount</code>	Returns the number of times the document has been changed since the last save or, for new documents which have not yet been saved, since the document was created. Useful for determining whether the Save and Revert items should be enabled or disabled.
<code>TXNDataSize</code>	Returns the size in bytes of the characters in the document. Useful for determining if the Save As, Page Setup and Print items should be enabled or disabled.

## Functions Relevant to the Edit Menu

The following functions are relevant to your application's Edit menu:

<i>Function</i>	<i>Description</i>
<code>TXNCanUndo</code>	Returns <code>true</code> if the last action is undoable, in which case the Undo item should be enabled.
<code>TXNCanRedo</code>	Returns <code>true</code> if the last action is redoable, in which case the Redo item should be enabled.

<i>Function</i>	<i>Description</i>
TXNUndo	Undoes the last action.
TXNRedo	Re-does the last action.
TXNCut	Cuts the current selection to the MLTE private scrap.
TXNCopy	Copies the current selection to the MLTE private scrap.
TXNPaste	Pastes the MLTE private scrap to the document.
TXNClear	Clears the current selection.
TXNSelectAll	Selects everything in a frame.
TXNIsSelectionEmpty	Returns false if the current selection is not empty, in which case the Cut, Copy, and Clear items should be enabled.
TXNIsScrapPastable	Returns true if the current MLTE scrap is pastable, in which case the Paste item should be enabled.
TXNConvertToPublicScrap	Converts the MLTE private scrap to the public clipboard. In Carbon applications, this function should not be called on suspend events. Typically, it should be called immediately after TXNCut and TXNCopy.
TXNDataSize	Returns the size in bytes of the characters in the document. Useful for determining if the Select All item should be enabled or disabled.

Note that, in Carbon applications, there is no need to call `TXNConvertFromPublicScrap` to convert the public clipboard to the MLTE private scrap. In Carbon applications, MLTE automatically keeps the public scrap and private scrap synchronised.

## More on TXNCanUndo and TXNCanRedo

When `TXNCanUndo` and `TXNCanRedo` return true, they also return in their `oTXNActionKey` parameters an **action key**, which can be used by your application to load an indexed string describing the undoable or re-doable action. The Undo and Redo items should be set to this string using `SetMenuItemText`. The following are the main action key constants:

<code>kTXNTypingAction</code>	<code>kTXNChangeFontColorAction</code>	<code>kTXNAlignLeftAction</code>
<code>kTXNCutAction</code>	<code>kTXNChangeFontSizeAction</code>	<code>kTXNAlignRightAction</code>
<code>kTXNPasteAction</code>	<code>kTXNChangeStyleAction</code>	<code>kTXNAlignCenterAction</code>
<code>kTXNClearAction</code>	<code>kTXNMoveAction</code>	<code>kTXNUndoLastAction</code>
<code>kTXNChangeFontAction</code>	<code>kTXNDropAction</code>	



## Creating, Preparing, and Handling the Font Menu

MLTE contains functions that greatly simplify the task of creating and managing the Font menu.

The `TXNNewFontMenuObject` function may be used to create a hierarchical Font menu. A reference to the (empty) Font menu, the menu ID, and the starting ID for the sub-menus are passed in the first three parameters, and a pointer to a `TXNFontMenuObject` is returned in the fourth parameter. The starting ID for the sub-menus must be 160 or higher.

To prepare the Font menu for display when the user clicks in the menu bar, you should simply call `TXNPrepareFontMenu`, which checks and unchecks items in the Font menu as appropriate.

A call to `TXNDoFontMenuSelection`, with the `TXNFontMenuObject` obtained by the call to `TXNNewFontMenuObject` passed in the second parameter and the menu ID and chosen menu item passed in the third and fourth parameters, sets the chosen font and changes the current selection to that font.

At program termination, you should call `TXNDisposeFontMenuObject` to dispose of the `TXNFontMenuObject` and its menu handle.

## Setting Data

You can replace a specified range with data by calling `TXNSetData`.

```
OSStatus TXNSetData(TXNObject iTXNObject, TXNDataType iDataType, void * iDataPtr,
                    ByteCount iDataSize, TXNOffset iStartOffset, TXNOffset iEndOffset);
```

**iDataType** The type of data. Relevant constants are

```
kTXNTextData
kTXNPictureData
kTXNMovieData
kTXNSoundData
kTXNUnicodeTextData
```

**iDataPtr** A pointer to the new data.

**iDataSize** The size of new data.

**iStartOffset** The offset to the beginning of the range to replace.

**iEndOffset** The offset to the end of range to replace.

You can replace a specified range with the contents of a specified file by calling `TXNSetDataFromFile`.

```
OSStatus TXNSetDataFromFile(TXNObject iTXNObject, Sint16 iFileRefNum, OSType iFileType,
                             ByteCount iFileLength, TXNOffset iStartOffset,
                             TXNOffset iEndOffset);
```

**IFileRefNum** The file reference number.

**IFileType** The file type. For file types supported by MLTE, the relevant constants are

`KTXNTextensionFile`  
`KTXNTextFile`  
`KTXNPictureFile`  
`KTXNMovieFile`  
`KTXNSoundFile`  
`KTXNAIFFFile`  
`KTXNUnicodeTextFile`

**iFileLength** How much data should be read. Ignored if the file type is a file type that MLTE supports.

This parameter is useful when you want data that is embedded in the file. For the whole file, pass `KTXNEndOffset` in this parameter.

**IStartOffset** The offset to the beginning of the range to replace.

**IEndOffset** The offset to the end of range to replace.

The data fork of the file must be opened and the file mark set by the application. MLTE does not move the file's marker before reading the data.

# Main Constants, Data Types, and Functions

## Constants

### Initializing

`KTXNWantMoviesMask` = `1L << KTXNWantMoviesBit`  
`KTXNWantSoundMask` = `1L << KTXNWantSoundBit`  
`KTXNWantGraphicsMask` = `1L << KTXNWantGraphicsBit`

### Text Encoding

`KTXNSystemDefaultEncoding` = `0`  
`KTXNMacOSEncoding` = `1`  
`KTXNUnicodeEncoding` = `2`

### Frame Options

`KTXNShowWindowMask` = `1L << KTXNShowWindowBit`  
`KTXNWantHScrollBarMask` = `1L << KTXNWantHScrollBarBit`  
`KTXNWantVScrollBarMask` = `1L << KTXNWantVScrollBarBit`  
`KTXNNoSelectionMask` = `1L << KTXNNoSelectionBit`

### Frame Types

`KTXNTextEditStyleFrameType` = `1`  
`KTXNPageFrameType` = `2`  
`KTXNMultipleFrameType` = `3`

## Global Layout

```

kTXNJustificationTag      = FOUR_CHAR_CODE('just')
kTXNTabSettingsTag        = FOUR_CHAR_CODE('tabs')
kTXNMarginsTag            = FOUR_CHAR_CODE('marg')
kTXNWordWrapStateTag      = FOUR_CHAR_CODE('wwrs')
kTXNFlushDefault          = 0
kTXNFlushLeft             = 1
kTXNFlushRight            = 2
kTXNCenter                = 4
kTXNFullJust              = 8
kTXNForceFullJust         = 16
kTXNAutoWrap              = false
kTXNNoAutoWrap            = true
kTXNRightTab              = -1
kTXNLeftTab               = 0
kTXNCenterTab             = 1

```

## Setting the Background

```

kTXNBackgroundTypeRGB     = 1

```

## Type Attributes

```

kTXNSizeContinuousMask    = 1L << kTXNSizeContinuousBit
kTXNStyleContinuousMask   = 1L << kTXNStyleContinuousBit
kTXNColorContinuousMask   = 1L << kTXNColorContinuousBit
kTXNQDFontSizeAttribute   = FOUR_CHAR_CODE('size')
kTXNQDFontStyleAttribute  = FOUR_CHAR_CODE('face')
kTXNQDFontColorAttribute  = FOUR_CHAR_CODE('klor')
kTXNFontSizeAttributeSize = sizeof(Fixed)
kTXNQDFontStyleAttributeSize = sizeof(Style)
kTXNQDFontColorAttributeSize = sizeof(RGBColor)

```

## Data Types

```

kTXNTextData              = FOUR_CHAR_CODE('TEXT')
kTXNPictureData           = FOUR_CHAR_CODE('PICT')
kTXNMovieData             = FOUR_CHAR_CODE('moov')
kTXNSoundData             = FOUR_CHAR_CODE('snd ')
kTXNUnicodeTextData       = FOUR_CHAR_CODE('utxt')

```

## File Types

```

kTXNTextensionFile        = FOUR_CHAR_CODE('txtn')
kTXNTextFile              = FOUR_CHAR_CODE('TEXT')
kTXNPictureFile           = FOUR_CHAR_CODE('PICT')
kTXNMovieFile             = FOUR_CHAR_CODE('MooV')
kTXNSoundFile             = FOUR_CHAR_CODE('sfil')
kTXNAIFFFile              = FOUR_CHAR_CODE('AIFF')
kTXNUnicodeTextFile       = FOUR_CHAR_CODE('utxt')

```

## Undo/Redo Action Keys

```

kTXNTypingAction          = 0
kTXNCutAction             = 1
kTXNPasteAction           = 2
kTXNClearAction           = 3
kTXNChangeFontAction      = 4
kTXNChangeFontColorAction = 5
kTXNChangeFontSizeAction  = 6

```

```

kTXNChangeStyleAction      = 7
kTXNAlignLeftAction        = 8
kTXNAlignCenterAction      = 9
kTXNAlignRightAction       = 10
kTXNDropAction             = 11
kTXNMoveAction             = 12
kTXNUndoLastAction         = 1024

```

## Saving Text Files—Style Information

```

kTXNSingleStylePerTextDocumentResType = FOUR_CHAR_CODE('MPSR')
kTXNMultipleStylesPerTextDocumentResType = FOUR_CHAR_CODE('styl')

```

## Data Types

```

typedef struct OpaqueTXNObject*      TXNObject;
typedef struct OpaqueTXNFontMenuObject* TXNFontMenuObject;
typedef UInt32                       TXNFrameID;
typedef OptionBits                   TXNInitOptions;
typedef UInt32                       TXNPermanentTextEncodingType;
typedef OptionBits                   TXNFrameOptions;
typedef UInt32                       TXNFrameType;
typedef UInt32                       TXNBackgroundType;
typedef FourCharCode                 TXNControlTag;
typedef SInt8                        TXNTabType;
typedef OptionBits                   TXNContinuousFlags;
typedef ByteCount                    TXNTypeRunAttributeSizes;
typedef OSType                       TXNDataType;
typedef OSType                       TXNFileType;
typedef UInt32                       TXNActionKey;

```

## Global Layout

```

union TXNControlData
{
    UInt32      uValue;
    SInt32      sValue;
    TXNTab      tabValue;
    TXNMargins * marginsPtr;
};

typedef union TXNControlData TXNControlData;

struct TXNTab
{
    SInt16      value;
    TXNTabType tabType;
    UInt8       filler;
};

typedef struct TXNTab TXNTab;

struct TXNMargins
{
    SInt16 topMargin;
    SInt16 leftMargin;
    SInt16 bottomMargin;
    SInt16 rightMargin;
};

typedef struct TXNMargins TXNMargins;

```

## Setting the Background

```
struct TXNBackground
{
    TXNBackgroundType bgType;
    TXNBackgroundData bg;
};
typedef struct TXNBackground TXNBackground;

union TXNBackgroundData
{
    RGBColor color;
};
typedef union TXNBackgroundData TXNBackgroundData;
```

## Type Attributes

```
struct TXNTypeAttributes
{
    TXNTag          tag;
    ByteCount       size;
    TXNAttributeData data;
};
typedef struct TXNTypeAttributes TXNTypeAttributes;

union TXNAttributeData
{
    void *          dataPtr;
    UInt32          dataValue;
    TXNATSUIFeatures * atsuFeatures;
    TXNATSUIVariations * atsuVariations;
};
typedef union TXNAttributeData TXNAttributeData;
```

## Font Description

```
struct TXNMacOSPreferredFontDescription
{
    UInt32          fontID;
    Fixed           pointSize;
    TextEncoding    encoding;
    Style           fontStyle;
};
typedef struct TXNMacOSPreferredFontDescription TXNMacOSPreferredFontDescription;
```

## Functions

### Initializing and Terminating

```
void TXNTerminateTextension(void);
OSStatus TXNInitTextension(const TXNMacOSPreferredFontDescription iDefaultFonts[],
    ItemCount iCountDefaultFonts, TXNInitOptions iUsageFlags);
```

### Allocating and Deleting TXNObject

```
OSStatus TXNNewObject(const FSSpec *iFileSpec, WindowRef iWindow, Rect *iFrame,
    TXNFrameOptions iFrameOptions, TXNFrameType iFrameType, TXNFileType iFileType,
```

```

        TXNPermanentTextEncodingType iPermanentEncoding, TXNObject *oTXNObject,
        TXNFrameID *oTXNFrameID, TXNObjectRefcon iRefCon);
void TXNDeleteObject(TXNObject iTXNObject);

```

## Attaching an Object to a Window

```

OSStatus TXNAttachObjectToWindow(TXNObject iTXNObject, GWorldPtr iWindow,
    Boolean iIsActualWindow);
Boolean TXNIsObjectAttachedToWindow(TXNObject iTXNObject);

```

## Resizing the Frame

```

void TXNResizeFrame(TXNObject iTXNObject, UInt32 iWidth, UInt32 iHeight,
    TXNFrameID iTXNFrameID);

```

## Setting and Getting Global Layout Settings

```

OSStatus TXNSetTXNObjectControls(TXNObject iTXNObject, Boolean iClearAll,
    ItemCount iControlCount, TXNControlTag iControlTags[], TXNControlData iControlData[]);
OSStatus TXNGetTXNObjectControls(TXNObject iTXNObject, ItemCount iControlCount,
    TXNControlTag iControlTags[], TXNControlData oControlData[]);

```

## Setting the Background

```

OSStatus TXNSetBackground(TXNObject iTXNObject, TXNBackground *iBackgroundInfo);

```

## Setting and Getting Type Attributes

```

OSStatus TXNSetTypeAttributes(TXNObject iTXNObject, ItemCount iAttrCount,
    TXNTypeAttributes iAttributes[], TXNOffset iStartOffset, TXNOffset iEndOffset);
OSStatus TXNGetContinuousTypeAttributes(TXNObject iTxnObject,
    TXNContinuousFlags *oContinuousFlags, ItemCount iCount,
    TXNTypeAttributes ioTypeAttributes[]);

```

## Event Handling

```

void TXNClick(TXNObject iTXNObject, const EventRecord *iEvent);
void TXNUpdate(TXNObject iTXNObject);
void TXNForceUpdate(TXNObject iTXNObject);
void TXNDraw(TXNObject iTXNObject, GWorldPtr iDrawPort);
OSStatus TXNActivate(TXNObject iTXNObject, TXNFrameID iTXNFrameID,
    TXNScrollBarState iActiveState);
void TXNFocus(TXNObject iTXNObject, Boolean iBecomingFocused);
void TXNAdjustCursor(TXNObject iTXNObject, RgnHandle ioCursorRgn);
void TXNZoomWindow(TXNObject iTXNObject, short iPart);
void TXNGrowWindow(TXNObject iTXNObject, const EventRecord *iEvent);
UInt32 TXNGetSleepTicks(TXNObject iTXNObject);

```

## Functions Relevant to the File Menu

```

OSStatus TXNSave(TXNObject iTXNObject, TXNFileType iType, OSType iResType,
    TXNPermanentTextEncodingType iPermanentEncoding, FSSpec *iFileSpecification,
    SInt16 iDataReference, SInt16 iResourceReference);
OSStatus TXNRevert(TXNObject iTXNObject);
OSStatus TXNPageSetup(TXNObject iTXNObject);
OSStatus TXNPrint(TXNObject iTXNObject);

```

### Functions Relevant to the Edit Menu

```
Boolean  TXNCanUndo(TXNObject iTXNObject, TXNActionKey *oTXNActionKey);
Boolean  TXNCanRedo(TXNObject iTXNObject, TXNActionKey *oTXNActionKey);
void     TXNUndo(TXNObject iTXNObject);
void     TXNRedo(TXNObject iTXNObject);
OSStatus TXNCut(TXNObject iTXNObject);
OSStatus TXNCopy(TXNObject iTXNObject);
OSStatus TXNPaste(TXNObject iTXNObject);
OSStatus TXNClear(TXNObject iTXNObject);
void     TXNSelectAll(TXNObject iTXNObject);
```

### Creating, Preparing, Handling, and Disposing of the Font Menu

```
OSStatus TXNNewFontMenuObject(MenuRef iFontMenuHandle, SInt16 iMenuID,
                              SInt16 iStartHierMenuID, TXNFontMenuObject *oTXNFontMenuObject);
OSStatus TXNPrepareFontMenu(TXNObject iTXNObject, TXNFontMenuObject iTXNFontMenuObject);
OSStatus TXNDoFontMenuSelection(TXNObject iTXNObject, TXNFontMenuObject iTXNFontMenuObject,
                                SInt16 iMenuID, SInt16 iMenuItem);
OSStatus TXNGetFontMenuRef(TXNFontMenuObject iTXNFontMenuObject, MenuRef *oFontMenuHandle);
OSStatus TXNDisposeFontMenuObject(TXNFontMenuObject iTXNFontMenuObject);
```

### Selections

```
Boolean  TXNIsEmptySelection(TXNObject iTXNObject);
void     TXNGetSelection(TXNObject iTXNObject, TXNOffset *oStartOffset, TXNOffset *oEndOffset);
void     TXNShowSelection(TXNObject iTXNObject, Boolean iShowEnd);
OSStatus TXNSetSelection(TXNObject iTXNObject, TXNOffset iStartOffset, TXNOffset iEndOffset);
```

### Setting Data

```
ByteCount TXNDataSize(TXNObject iTXNObject);
OSStatus TXNGetData(TXNObject iTXNObject, TXNOffset iStartOffset, TXNOffset iEndOffset,
                    Handle *oDataHandle);
OSStatus TXNSetDataFromFile(TXNObject iTXNObject, SInt16 iFileRefNum, OSType iFileType,
                             ByteCount iFileLength, TXNOffset iStartOffset, TXNOffset iEndOffset);
```

### Getting the Change Count

```
ItemCount TXNGetChangeCount(TXNObject iTXNObject);
```

### Scrap

```
Boolean  TXNIsScrapPastable(void);
OSStatus TXNConvertToPublicScrap(void);
```

### Font Defaults

```
OSStatus TXNSetFontDefaults(TXNObject iTXNObject, ItemCount iCount,
                             TXNMacOSPreferredFontDescription iFontDefaults[]);
OSStatus TXNGetFontDefaults(TXNObject iTXNObject, ItemCount *ioCount,
                             TXNMacOSPreferredFontDescription iFontDefaults[]);
```

## Demonstration Program MLTETextEditor Listing

```
// *****
// MTLETextEditor.h CLASSIC EVENT MODEL
// *****
//
// This program demonstrates the use of the Multilingual Text Engine API to create a basic
// multi-styled text editor. New documents created by the program are created and saved as
// Textension ('txtn') documents. Existing 'TEXT' documents and Unicode ('utxt') documents
// are saved in the original format. In the case of 'TEXT' documents, style information is
// saved in a 'styl' resource.
//
// The program utilises the following resources:
//
// · A 'plst' resource.
//
// · An 'MBAR' resource, and 'MENU' resources for Apple, File, Edit, Size, Style, Color,
//   and Justification (preload, non-purgeable).
//
// · A 'WIND' resource (purgeable) (initially not visible).
//
// · A 'STR ' resource (purgeable) containing the "missing application name" string, which is
//   copied to all document files created by the program.
//
// · 'STR#' resources (purgeable) containing error strings, the application's name (for
//   certain Navigation Services functions), and strings for the Edit menu Undo and Redo
//   items.
//
// · A 'kind' resource (purgeable) describing file types, which is used by Navigation
//   Services to build the native file types section of the Show pop-up menu in the Open
//   dialog box.
//
// · An 'open' resource (purgeable) containing the file type list for the Open dialog box.
//
// · The 'BNDL' resource (non-purgeable), 'FREF' resources (non-purgeable), signature
//   resource (non-purgeable), and icon family resources (purgeable), required to support the
//   built application.
//
// · A 'SIZE' resource with the acceptSuspendResumeEvents, canBackground,
//   doesActivateOnFGSwitch, and isHighLevelEventAware flags set.
//
// *****
// ..... includes
//
#include <Carbon.h>
// ..... defines
//
#define rMenubar 128
#define mAppleApplication 128
#define iAbout 1
```



```

#define mFile 129
#define iNew 1
#define iOpen 2
#define iClose 4
#define iSave 5
#define iSaveAs 6
#define iRevert 7
#define iPageSetup 9
#define iPrint 10
#define iQuit 12
#define mEdit 130
#define iUndo 1
#define iRedo 2
#define iCut 4
#define iCopy 5
#define iPaste 6
#define iClear 7
#define iSelectAll 8
#define mFont 131
#define mSize 132
#define iTwelve 4
#define mStyle 133
#define iPlain 1
#define iBold 3
#define iUnderline 5
#define mColor 134
#define iBlack 4
#define iColorPicker 6
#define mJustification 135
#define iDefault 1
#define iLeft 2
#define iForceFull 6
#define mWindow 136
#define mFirstHierarchical 160

#define rNewWindow 128
#define rAboutDialog 128
#define rErrorStrings 128
#define eInstallHandler 1000
#define eMaxWindows 1001
#define eCantFindFinderProcess 1002
#define rMiscellaneousStrings 129
#define sApplicationName 1
#define rOpenResource 128

#define kMaxWindows 8
#define kOpen 0
#define kPrint 1
#define kFileCreator 'bbJk'
#define MAX_UINT32 0xFFFFFFFF
#define MIN(a,b) ((a) < (b) ? (a) : (b))
#define topLeft(r) (((Point *) &(r))[0])

#define KATSUCGContextTag 32767L

```

// ..... function prototypes

```

void      main                                (void);
void      doPreliminaries                    (void);
void      doInitialiseMTLE                   (void);
void      doInstallAEHandlers                (void);
void      eventLoop                          (void);
UInt32    doGetSleepTime                     (void);
void      doIdle                             (void);
void      doEvents                           (EventRecord *);
void      doMouseDown                        (EventRecord *);
void      doBringFinderToFront               (void);
OSStatus  doFindProcess                      (OSType, OSType, ProcessSerialNumber *);
void      doActivate                         (EventRecord *);
void      doUpdate                           (EventRecord *);
Boolean   isApplicationWindow                (WindowRef, TXNObject *);
void      doAboutDialog                      (void);
void      doSynchroniseFiles                 (void);
OSStatus  openAppEventHandler                 (AppleEvent *, AppleEvent *, SInt32);
OSStatus  reopenAppEventHandler               (AppleEvent *, AppleEvent *, SInt32);
OSStatus  openAndPrintDocsEventHandler       (AppleEvent *, AppleEvent *, SInt32);
OSStatus  quitAppEventHandler                (AppleEvent *, AppleEvent *, SInt32);
OSStatus  doHasGotRequiredParams             (AppleEvent *);
void      doErrorAlert                       (SInt16);
void      doCopyPString                      (Str255, Str255);
void      doConcatPStrings                   (Str255, Str255);

void      doEnableDisableMenus               (Boolean);
void      doAdjustAndPrepareMenus            (void);
void      doAdjustFileMenu                   (MenuRef, WindowRef);
void      doAdjustEditMenu                   (MenuRef, WindowRef);
void      doPrepareFontMenu                  (WindowRef);
void      doPrepareSizeMenu                  (MenuRef, WindowRef);
void      doPrepareStyleMenu                 (MenuRef, WindowRef);
void      doPrepareColorMenu                 (MenuRef, WindowRef);
Boolean   isEqualRGB                         (RGBColor *, RGBColor *);
void      doPrepareJustificationMenu          (MenuRef, WindowRef);
void      doMenuChoice                       (SInt32);
void      doFileMenuChoice                   (MenuItemIndex, WindowRef);
void      doEditMenuChoice                   (MenuItemIndex, WindowRef);
void      doFontMenuChoice                   (MenuID, MenuItemIndex, WindowRef);
void      doSizeMenuChoice                   (MenuItemIndex, WindowRef);
void      doStyleMenuChoice                  (MenuItemIndex, WindowRef);
void      doColorMenuChoice                  (MenuItemIndex, WindowRef);
void      doJustificationMenuChoice           (MenuItemIndex, WindowRef);

OSStatus  doNewCommand                       (void);
OSStatus  doOpenCommand                      (void);
OSStatus  doCloseCommand                     (NavAskSaveChangesAction);
OSStatus  doSaveCommand                      (void);
OSStatus  doSaveAsCommand                    (void);
OSStatus  doRevertCommand                    (void);
OSStatus  doQuitCommand                      (NavAskSaveChangesAction);
OSStatus  doNewDocWindow                     (WindowRef *, FSSpec *, TXNFileType);

```

```

OSStatus doOpenFile                (FSSpec, OSType);
void doCloseWindow                 (WindowRef, TXNObject);
OSStatus doWriteFile               (WindowRef, Boolean);
OSStatus doCopyResources           (FSSpec, TXNFileType, Boolean);
OSStatus doCopyAResource           (ResType, SInt16, SInt16, SInt16);
void navEventFunction              (NavEventCallbackMessage, NavCBRecPtr,
                                   NavCallBackUserData);

// *****
// MLTETextEditor.c
// *****

// ..... includes

#include "MLTETextEditor.h"

// ..... global variables

SInt16 gAppResFileRefNum;
Boolean gRunningOnX = false;
Boolean gDone;
TXNFontMenuObject gTXNFontMenuObject;
RgnHandle gCursorRgnHdl;
extern SInt16 gCurrentNumberOfWindows;

// ***** main

void main(void)
{
    MenuBarHandle menubarHdl;
    SInt32 response;
    MenuRef menuRef;
    OSStatus osStatus = noErr;

    // ..... do preliminaries

    doPreliminaries();

    // ..... save application's resource file reference number

    gAppResFileRefNum = CurResFile();

    // ..... set up menu bar and menus

    menubarHdl = GetNewMBar(rMenubar);
    if(menubarHdl == NULL)
        doErrorAlert(MemError());
    SetMenuBar(menubarHdl);

    CreateStandardWindowMenu(0, &menuRef);
    SetMenuID(menuRef, mWindow);
    InsertMenu(menuRef, 0);
    DeleteMenuItem(menuRef, 1);

```

```

Gestalt(gestaltMenuMgrAttr,&response);
if(response & gestaltMenuMgrAquaLayoutMask)
{
    menuRef = GetMenuRef(mFile);
    if(menuRef != NULL)
    {
        DeleteMenuItem(menuRef,iQuit);
        DeleteMenuItem(menuRef,iQuit - 1);
    }

    gRunningOnX = true;
}

// ..... build hierarchical font menu and draw menu bar

menuRef = GetMenuRef(mFont);
osStatus = TXNNewFontMenuObject(menuRef,mFont,mFirstHierarchical,&gTXNFontMenuObject);
if(osStatus != noErr)
    doErrorAlert(osStatus);

DrawMenuBar();

// ..... install required Apple event handlers

doInstallAEHandlers();

// ..... enter event loop

eventLoop();
}

// ***** doPreliminaries

void doPreliminaries(void)
{
    MoreMasterPointers(960);
    InitCursor();
    FlushEvents(everyEvent,0);

    doInitialiseMTLE();
}

// ***** doInitializeMTLE

void doInitialiseMTLE(void)
{
    TXNMacOSPreferredFontDescription defaultFont[1];
    OSStatus osStatus = noErr;
    SInt16 fontID;

    GetFNum("\pNew York",&fontID);

    defaultFont[0].fontID = fontID;
    defaultFont[0].pointSize = 0x000C0000;

```

```

defaultFont[0].fontStyle = kTXNDefaultFontStyle;
defaultFont[0].encoding = kTXNSystemDefaultEncoding;

osStatus = TXNInitTextension(&defaultFont[0], 1, kTXNWantMoviesMask);
if(osStatus != noErr)
    doErrorAlert(osStatus);
}

// ***** doInstallAEHandlers

void doInstallAEHandlers(void)
{
    OSStatus osStatus = noErr;

    osStatus = AEInstallEventHandler(kCoreEventClass, kAEOpenApplication,
                                    NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) openAppEventHandler),
                                    0L, false);
    if(osStatus != noErr) doErrorAlert(eInstallHandler);

    osStatus = AEInstallEventHandler(kCoreEventClass, kAEReopenApplication,
                                    NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) reopenAppEventHandler),
                                    0L, false);
    if(osStatus != noErr) doErrorAlert(eInstallHandler);

    osStatus = AEInstallEventHandler(kCoreEventClass, kAEOpenDocuments,
                                    NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) openAndPrintDocsEventHandler),
                                    kOpen, false);
    if(osStatus != noErr) doErrorAlert(eInstallHandler);

    osStatus = AEInstallEventHandler(kCoreEventClass, kAEPrintDocuments,
                                    NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) openAndPrintDocsEventHandler),
                                    kPrint, false);
    if(osStatus != noErr) doErrorAlert(eInstallHandler);

    osStatus = AEInstallEventHandler(kCoreEventClass, kAEQuitApplication,
                                    NewAEEEventHandlerUPP((AEEEventHandlerProcPtr) quitAppEventHandler),
                                    0L, false);
    if(osStatus != noErr) doErrorAlert(eInstallHandler);
}

// ***** eventLoop

void eventLoop(void)
{
    EventRecord eventStructure;

    gDone = false;
    gCursorRgnHdl = NewRgn();

    while(!gDone)
    {
        if(WaitNextEvent(everyEvent, &eventStructure, doGetSleepTime(), gCursorRgnHdl))
            doEvents(&eventStructure);
    }
}

```

```

    else
    {
        if(eventStructure.what == nullEvent)
        {
            doIdle();
            doSynchroniseFiles();
        }
    }
}

// ***** doGetSleepTime

UInt32 doGetSleepTime(void)
{
    WindowRef windowRef;
    UInt32 sleepTime;
    TXNObject txnObject = NULL;

    windowRef = FrontWindow();

    if(isApplicationWindow(windowRef,&txnObject))
        sleepTime = TXNGetSleepTicks(txnObject);
    else
        sleepTime = GetCaretTime();

    return sleepTime;
}

// ***** doIdle

void doIdle(void)
{
    WindowRef windowRef;
    TXNObject txnObject = NULL;

    windowRef = FrontWindow();
    if(isApplicationWindow(windowRef,&txnObject))
    {
        if(TXNGetChangeCount(txnObject))
            SetWindowModified(windowRef,true);
    }
}

// ***** doEvents

void doEvents(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    TXNObject txnObject = NULL;

    switch(eventStrucPtr->what)
    {
        case kHighLevelEvent:
            AEProcessAppleEvent(eventStrucPtr);
            break;
    }
}

```

```

    case mouseDown:
        doMouseDown(eventStrucPtr);
        break;

    case keyDown:
        if(eventStrucPtr->modifiers & cmdKey)
        {
            doAdjustAndPrepareMenus();
            doMenuChoice(MenuEvent(eventStrucPtr));
        }
        break;

    case updateEvt:
        doUpdate(eventStrucPtr);
        break;

    case activateEvt:
        doActivate(eventStrucPtr);
        break;

    case osEvt:
        switch((eventStrucPtr->message >> 24) & 0x000000FF)
        {
            case suspendResumeMessage:
                if(eventStrucPtr->message & resumeFlag)
                    SetThemeCursor(kThemeArrowCursor);
                break;

            case mouseMovedMessage:
                windowRef = FrontWindow();
                if(isApplicationWindow(windowRef,&txnObject))
                    TXNAdjustCursor(txnObject,gCursorRgnHdl);
        }
        break;
    }
}

// ***** doMouseDown

void doMouseDown(EventRecord *eventStrucPtr)
{
    WindowRef      windowRef;
    WindowPartCode partCode;
    OSStatus        osStatus = noErr;
    TXNObject       txnObject = NULL;
    Boolean          handled = false;
    SInt32           itemSelected;

    partCode = FindWindow(eventStrucPtr->where,&windowRef);

    switch(partCode)
    {
        case inMenuBar:
            doAdjustAndPrepareMenus();
            doMenuChoice(MenuSelect(eventStrucPtr->where));
            break;
    }
}

```

```

case inContent:
    if(windowRef != FrontWindow())
        SelectWindow(windowRef);
    else
    {
        if(isApplicationWindow(windowRef,&txnObject))
            TXNClick(txnObject,eventStrucPtr);
    }
    break;

case inGoAway:
    if(TrackGoAway(windowRef,eventStrucPtr->where))
        doCloseCommand(kNavSaveChangesClosingDocument);
    break;

case inProxyIcon:
    osStatus = TrackWindowProxyDrag(windowRef,eventStrucPtr->where);
    if(osStatus == errUserWantsToDragWindow)
        handled = false;
    else if(osStatus == noErr)
        handled = true;

case inDrag:
    if(!handled)
    {
        if(IsWindowPathSelectClick(windowRef,eventStrucPtr))
        {
            if(WindowPathSelect(windowRef,NULL,&itemSelected) == noErr)
            {
                if(LoWord(itemSelected) > 1)
                    doBringFinderToFront();
            }

            handled = true;
        }
    }
    if(!handled)
        DragWindow(windowRef,eventStrucPtr->where,NULL);

    if(isApplicationWindow(windowRef,&txnObject))
        TXNAdjustCursor(txnObject,gCursorRgnHdl);

    break;

case inGrow:
    if(isApplicationWindow(windowRef,&txnObject))
    {
        TXNGrowWindow(txnObject,eventStrucPtr);
        TXNAdjustCursor(txnObject,gCursorRgnHdl);
    }
    break;

case inZoomIn:
case inZoomOut:
    if(TrackBox(windowRef,eventStrucPtr->where,partCode))

```



```

        {
            if(isApplicationWindow(windowRef,&txnObject))
            {
                TXNZoomWindow(txnObject,partCode);
                TXNAdjustCursor(txnObject,gCursorRgnHdl);
            }
        }
        break;
    }
}

// ***** doBringFinderToFront

void doBringFinderToFront(void)
{
    ProcessSerialNumber finderProcess;

    if(doFindProcess('MACS','FNDR",&finderProcess) == noErr)
        SetFrontProcess(&finderProcess);
    else
        doErrorAlert(eCantFindFinderProcess);
}

// ***** doFindProcess

OSStatus doFindProcess(OSType creator,OSType type,ProcessSerialNumber *outProcSerNo)
{
    ProcessSerialNumber procSerialNo;
    ProcessInfoRec      procInfoStruc;
    OSStatus             osStatus = noErr;

    procSerialNo.highLongOfPSN = 0;
    procSerialNo.lowLongOfPSN  = kNoProcess;

    procInfoStruc.processInfoLength = sizeof(ProcessInfoRec);
    procInfoStruc.processName       = NULL;
    procInfoStruc.processAppSpec    = NULL;
    procInfoStruc.processLocation   = NULL;

    while(true)
    {
        osStatus = GetNextProcess(&procSerialNo);
        if(osStatus != noErr)
            break;

        osStatus = GetProcessInformation(&procSerialNo,&procInfoStruc);
        if(osStatus != noErr)
            break;
        if((procInfoStruc.processSignature == creator) && (procInfoStruc.processType == type))
            break;
    }

    *outProcSerNo = procSerialNo;

    return osStatus;
}

```

```
// ***** doActivate

void doActivate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    TXNObject txnObject = NULL;
    Boolean becomingActive;
    TXNFrameID txnFrameID = 0;

    windowRef = (WindowRef) eventStrucPtr->message;

    if(isApplicationWindow(windowRef,&txnObject))
    {
        becomingActive = ((eventStrucPtr->modifiers & activeFlag) == activeFlag);
        GetWindowProperty(windowRef,kFileCreator,'tFRM',sizeof(TXNFrameID),NULL,&txnFrameID);

        if(becomingActive)
            TXNActivate(txnObject,txnFrameID,becomingActive);
        else
            TXNActivate(txnObject,txnFrameID,becomingActive);

        TXNFocus(txnObject,becomingActive);
    }
}

// ***** doUpdate

void doUpdate(EventRecord *eventStrucPtr)
{
    WindowRef windowRef;
    GrafPtr oldPort;
    TXNObject txnObject = NULL;

    windowRef = (WindowRef) eventStrucPtr->message;

    GetPort(&oldPort);
    SetPortWindowPort(windowRef);

    if(isApplicationWindow(windowRef,&txnObject))
        TXNUpdate(txnObject);

    SetPort(oldPort);
}

// ***** isApplicationWindow

Boolean isApplicationWindow(WindowRef windowRef,TXNObject *txnObject)
{
    OSStatus osStatus = noErr;

    osStatus = GetWindowProperty(windowRef,kFileCreator,'tOBJ',sizeof(TXNObject),NULL,
                                txnObject);

    return (windowRef != NULL) && (GetWindowKind(windowRef) == kApplicationWindowKind);
}
```

```
// ***** doAboutDialog

void doAboutDialog(void)
{
    DialogRef dialogRef;
    SInt16 itemHit;

    dialogRef = GetNewDialog(rAboutDialog,NULL,(WindowRef) -1);
    ModalDialog(NULL,&itemHit);
    DisposeDialog(dialogRef);
}

// ***** doSynchroniseFiles

void doSynchroniseFiles(void)
{
    UInt32 currentTicks;
    WindowRef windowRef;
    static UInt32 nextSynchTicks = 0;
    OSStatus hasNoAliasHdl = noErr;
    Boolean aliasChanged;
    AliasHandle aliasHdl = NULL;
    FSSpec newFSSpec;
    OSStatus osStatus = noErr;
    SInt16 trashVRefNum;
    SInt32 trashDirID;
    TXNObject txnObject = NULL;

    currentTicks = TickCount();
    windowRef = FrontWindow();

    if(currentTicks > nextSynchTicks)
    {
        while(windowRef != NULL)
        {
            hasNoAliasHdl = GetWindowProperty(windowRef,kFileCreator,'tALH',sizeof(AliasHandle),
                                                NULL,&aliasHdl);

            if(hasNoAliasHdl)
                break;

            aliasChanged = false;
            ResolveAlias(NULL,aliasHdl,&newFSSpec,&aliasChanged);
            if(aliasChanged)
            {
                SetWindowProperty(windowRef,kFileCreator,'FiSp',sizeof(FSSpec),&newFSSpec);
                SetWTitle(windowRef,newFSSpec.name);
            }

            osStatus = FindFolder(kUserDomain,kTrashFolderType,kDontCreateFolder,
                                  &trashVRefNum,&trashDirID);

            if(osStatus == noErr)
            {
                do
```

```

    {
        if(newFSSpec.parID == fsRtParID)
            break;

        if((newFSSpec.vRefNum == trashVRefNum) && (newFSSpec.parID == trashDirID))
        {
            GetWindowProperty(windowRef,kFileCreator,'tOBJ',sizeof(TXNObject),NULL,
                            &txnObject);
            TXNDeleteObject(txnObject);
            DisposeWindow(windowRef);
            gCurrentNumberOfWindows --;
            break;
        }
    } while(FSMakeFSSpec(newFSSpec.vRefNum,newFSSpec.parID,"\\p",&newFSSpec) == noErr);
}

windowRef = GetNextWindow(windowRef);
}

nextSynchTicks = currentTicks + 15;
}
}

// ***** openAppEventHandler

OSStatus openAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,SInt32 handlerRefCon)
{
    OSStatus osStatus = noErr;

    osStatus = doHasGotRequiredParams(appEvent);
    if(osStatus == noErr)
        osStatus = doNewCommand();

    return osStatus;
}

// ***** reopenAppEventHandler

OSStatus reopenAppEventHandler(AppleEvent *appEvent,AppleEvent *reply,
                               SInt32 handlerRefCon)
{
    OSStatus osStatus = noErr;

    osStatus = doHasGotRequiredParams(appEvent);
    if(osStatus == noErr)
        if(!FrontWindow())
            osStatus = doNewCommand();

    return osStatus;
}

```

```
// ***** openAndPrintDocsEventHandler

OSStatus openAndPrintDocsEventHandler(AppleEvent *appEvent, AppleEvent *reply,
                                       SInt32 handlerRefcon)
{
    FSSpec      fileSpec;
    AEDescList  docList;
    OSStatus    osStatus, ignoreErr;
    SInt32      index, numberOfItems;
    Size        actualSize;
    AEKeyword   keyWord;
    DescType    returnedType;
    FInfo       fileInfo;
    TXNObject   txnObject;

    osStatus = AEGetParamDesc(appEvent, keyDirectObject, typeAEList, &docList);

    if (osStatus == noErr)
    {
        osStatus = doHasGotRequiredParams(appEvent);
        if (osStatus == noErr)
        {
            osStatus = AECountItems(&docList, &numberOfItems);
            if (osStatus == noErr)
            {
                for (index = 1; index <= numberOfItems; index++)
                {
                    osStatus = AEGetNthPtr(&docList, index, typeFSS, &keyWord, &returnedType,
                                             &fileSpec, sizeof(fileSpec), &actualSize);
                    if (osStatus == noErr)
                    {
                        osStatus = FspGetFInfo(&fileSpec, &fileInfo);
                        if (osStatus == noErr)
                        {
                            if (osStatus = doOpenFile(fileSpec, fileInfo.fdType))
                                doErrorAlert(osStatus);

                            if (osStatus == noErr && handlerRefcon == kPrint)
                            {
                                if (isApplicationWindow(FrontWindow(), &txnObject))
                                {
                                    if (osStatus = TXNPrint(txnObject))
                                        doErrorAlert(osStatus);

                                    if (osStatus = doCloseCommand(kNavSaveChangesOther))
                                        doErrorAlert(osStatus);
                                }
                            }
                        }
                    }
                }
            }
            else
                doErrorAlert(osStatus);
        }
    }
}
```

```

    else
        doErrorAlert(osStatus);

    ignoreErr = AEDisposeDesc(&docList);
}
else
    doErrorAlert(osStatus);

return osStatus;
}

// ***** quitAppEventHandler

OSStatus quitAppEventHandler(AppleEvent *appEvent, AppleEvent *reply, SInt32 handlerRefcon)
{
    OSStatus osStatus = noErr;

    osStatus = doHasGotRequiredParams(appEvent);
    if(osStatus == noErr)
    {
        while(FrontWindow())
        {
            osStatus = doCloseCommand(kNavSaveChangesQuittingApplication);

            if(osStatus != noErr && osStatus != kNavAskSaveChangesCancel)
                doErrorAlert(osStatus);
            if(osStatus == kNavAskSaveChangesCancel)
                return noErr;
        }
    }

    gDone = true;

    return osStatus;
}

// ***** doHasGotRequiredParams

OSStatus doHasGotRequiredParams(AppleEvent *appEvent)
{
    DescType returnedType;
    Size      actualSize;
    OSStatus osStatus = noErr;

    osStatus = AEGetAttributePtr(appEvent, keyMissedKeywordAttr, typeWildCard, &returnedType,
                                NULL, 0, &actualSize);
    if(osStatus == errAEDescNotFound)
        osStatus = noErr;
    else if(osStatus == noErr)
        osStatus = errAEParamMissed;

    return osStatus;
}

```

```
// ***** doErrorAlert

void doErrorAlert(SInt16 errorCode)
{
    Str255 errorString, theString;
    SInt16 itemHit;

    if(errorCode == kATSUFontsMatched)
        return;

    if(errorCode == eInstallHandler)
        GetIndString(errorString, rErrorStrings, 1);
    else if(errorCode == eMaxWindows)
        GetIndString(errorString, rErrorStrings, 2);
    else if(errorCode == eCantFindFinderProcess)
        GetIndString(errorString, rErrorStrings, 3);
    else
    {
        GetIndString(errorString, rErrorStrings, 4);
        NumToString((SInt32) errorCode, theString);
        doConcatPStrings(errorString, theString);
    }

    if(errorCode != memFullErr)
        StandardAlert(kAlertCautionAlert, errorString, NULL, NULL, &itemHit);
    else
    {
        StandardAlert(kAlertStopAlert, errorString, NULL, NULL, &itemHit);
        ExitToShell();
    }
}

// ***** doCopyPString

void doCopyPString(Str255 sourceString, Str255 destinationString)
{
    SInt16 stringLength;

    stringLength = sourceString[0];
    BlockMove(sourceString + 1, destinationString + 1, stringLength);
    destinationString[0] = stringLength;
}

// ***** doConcatPStrings

void doConcatPStrings(Str255 targetString, Str255 appendString)
{
    SInt16 appendLength;

    appendLength = MIN(appendString[0], 255 - targetString[0]);

    if(appendLength > 0)
    {
        BlockMoveData(appendString+1, targetString+targetString[0]+1, (SInt32) appendLength);
        targetString[0] += appendLength;
    }
}
```

```
// *****
// MLTETMenus.c
// *****

// ..... includes

#include "MLTETextEditor.h"

// ..... global variables

RGBColor          gCurrentColorPickerColor = { 0x0000,0x0000,0x0000 };
extern SInt16      gCurrentNumberOfWindows;
extern TXNFontMenuObject gTXNFontMenuObject;
extern Boolean     gDone;

// ***** doEnableDisableMenus

void doEnableDisableMenus(Boolean enableMenus)
{
    if(enableMenus)
    {
        EnableMenuItem(GetMenuRef(mEdit),0);
        EnableMenuItem(GetMenuRef(mFont),0);
        EnableMenuItem(GetMenuRef(mSize),0);
        EnableMenuItem(GetMenuRef(mStyle),0);
        EnableMenuItem(GetMenuRef(mColor),0);
        EnableMenuItem(GetMenuRef(mJustification),0);
        EnableMenuItem(GetMenuRef(mWindow),0);
    }
    else
    {
        DisableMenuItem(GetMenuRef(mEdit),0);
        DisableMenuItem(GetMenuRef(mFont),0);
        DisableMenuItem(GetMenuRef(mSize),0);
        DisableMenuItem(GetMenuRef(mStyle),0);
        DisableMenuItem(GetMenuRef(mColor),0);
        DisableMenuItem(GetMenuRef(mJustification),0);
        DisableMenuItem(GetMenuRef(mWindow),0);
    }
}

// ***** doAdjustAndPrepareMenus

void doAdjustAndPrepareMenus(void)
{
    WindowRef windowRef;

    windowRef = FrontWindow();

    doAdjustFileMenu(GetMenuRef(mFile),windowRef);
    doAdjustEditMenu(GetMenuRef(mEdit),windowRef);
    doPrepareFontMenu(windowRef);
    doPrepareSizeMenu(GetMenuRef(mSize),windowRef);
    doPrepareStyleMenu(GetMenuRef(mStyle),windowRef);
    doPrepareColorMenu(GetMenuRef(mColor),windowRef);
    doPrepareJustificationMenu(GetMenuRef(mJustification),windowRef);
}
```



```

    DrawMenuBar();
}

// ***** doAdjustFileMenu

void doAdjustFileMenu(MenuRef menuRef, WindowRef windowRef)
{
    TXNObject txnObject = NULL;

    if(gCurrentNumberOfWindows <= kMaxWindows)
    {
        EnableMenuItem(menuRef, iNew);
        EnableMenuItem(menuRef, iOpen);
    }
    else
    {
        DisableMenuItem(menuRef, iNew);
        DisableMenuItem(menuRef, iOpen);
    }

    if(isApplicationWindow(windowRef, &txnObject))
    {
        EnableMenuItem(menuRef, iClose);

        if(TXNGetChangeCount(txnObject))
        {
            EnableMenuItem(menuRef, iSave);
            EnableMenuItem(menuRef, iRevert);
        }
        else
        {
            DisableMenuItem(menuRef, iSave);
            DisableMenuItem(menuRef, iRevert);
        }

        if(TXNDataSize(txnObject))
        {
            EnableMenuItem(menuRef, iSaveAs);
            EnableMenuItem(menuRef, iPageSetup);
            EnableMenuItem(menuRef, iPrint);
        }
        else
        {
            DisableMenuItem(menuRef, iSaveAs);
            DisableMenuItem(menuRef, iPageSetup);
            DisableMenuItem(menuRef, iPrint);
        }
    }
    else
    {
        DisableMenuItem(menuRef, iClose);
        DisableMenuItem(menuRef, iSave);
        DisableMenuItem(menuRef, iSaveAs);
        DisableMenuItem(menuRef, iRevert);
    }
}

```

```

    DisableMenuItem(menuRef,iPageSetup);
    DisableMenuItem(menuRef,iPrint);
}
}

// ***** doAdjustEditMenu

void doAdjustEditMenu(MenuRef menuRef,WindowRef windowRef)
{
    TXNObject    txnObject = NULL;
    SInt16        menuItem;
    Str255        itemText;
    TXNActionKey  actionKey;

    if(isApplicationWindow(windowRef,&txnObject))
    {
        // ..... disable all items

        for(menuItem = iUndo;menuItem <= iSelectAll;menuItem ++)
            DisableMenuItem(menuRef,menuItem);

        // ..... undo and redo default - can't undo, can't redo

        GetIndString(itemText,130,1);
        SetMenuItemText(menuRef,iUndo,itemText);
        GetIndString(itemText,130,2);
        SetMenuItemText(menuRef,iRedo,itemText);

        // ..... if undoable, enable undo item and set item text

        if(TXNCanUndo(txnObject,&actionKey))
        {
            EnableMenuItem(menuRef,iUndo);

            if((actionKey < kTXNTypingAction) || (actionKey > kTXNMoveAction))
                actionKey = -1;

            GetIndString(itemText,130,2 * actionKey + 5);
            SetMenuItemText(menuRef,iUndo,itemText);
        }

        // ..... if redoable, enable redo item and set item text

        if(TXNCanRedo(txnObject,&actionKey))
        {
            EnableMenuItem(menuRef,iRedo);

            if((actionKey < kTXNTypingAction) || (actionKey > kTXNMoveAction))
                actionKey = -1;

            GetIndString(itemText,130,2 * actionKey + 6);
            SetMenuItemText(menuRef,iRedo,itemText);
        }
    }
}

```

```

// ..... if there is a selection, enable cut, copy, and clear

if(!TXNIsSelectionEmpty(txnObject))
{
    EnableMenuItem(menuRef,iCut);
    EnableMenuItem(menuRef,iCopy);
    EnableMenuItem(menuRef,iClear);
}

// ..... if scrap is pastable, enable paste

if(TXNIsScrapPastable())
    EnableMenuItem(menuRef,iPaste);

// ..... if any characters in TXNObject, enable select all

if(TXNDataSize(txnObject))
    EnableMenuItem(menuRef,iSelectAll);
}
}

// ***** doPrepareFontMenu

void doPrepareFontMenu(WindowRef windowRef)
{
    TXNObject txnObject = NULL;

    if(isApplicationWindow(windowRef,&txnObject))
        TXNPrepareFontMenu(txnObject,gTXNFontMenuObject);
}

// ***** doPrepareSizeMenu

void doPrepareSizeMenu(MenuRef menuRef,WindowRef windowRef)
{
    TXNObject txnObject = NULL;
    static Fixed itemSizes[8] = { 0x00090000,0x000A0000,0x000B0000,0x000C0000,
                                0x000E0000,0x00120000,0x00180000,0x00240000 };
    TXNContinuousFlags txnContinuousFlags = 0;
    TXNTypeAttributes txnTypeAttributes;
    OSStatus osStatus = noErr;
    SInt16 menuItem;

    if(isApplicationWindow(windowRef,&txnObject))
    {
        txnTypeAttributes.tag = kTXNQDFontSizeAttribute;
        txnTypeAttributes.size = kTXNFontSizeAttributeSize;
        txnTypeAttributes.data.dataValue = 0;

        osStatus = TXNGetContinuousTypeAttributes(txnObject,&txnContinuousFlags,1,
                                                    &txnTypeAttributes);

        if(osStatus == noErr)
        {
            for(menuItem = 1;menuItem < 8;menuItem++)

```

```

    {
        CheckMenuItem(menuRef,menuItem,(txnContinuousFlags & kTXNSizeContinuousMask) &&
            (txnTypeAttributes.data.dataValue == itemSizes[menuItem - 1]));
    }
}

// ***** doPrepareStyleMenu

void doPrepareStyleMenu(MenuRef menuRef,WindowRef windowRef)
{
    TXNObject          txnObject = NULL;
    TXNContinuousFlags txnContinuousFlags = 0;
    TXNTypeAttributes  txnTypeAttributes;
    OSStatus           osStatus = noErr;
    SInt16             menuItem;

    if(isApplicationWindow(windowRef,&txnObject))
    {
        txnTypeAttributes.tag          = kTXNQDFontStyleAttribute;
        txnTypeAttributes.size         = kTXNQDFontStyleAttributeSize;
        txnTypeAttributes.data.dataValue = 0;

        osStatus = TXNGetContinuousTypeAttributes(txnObject,&txnContinuousFlags,1,
            &txnTypeAttributes);

        if(osStatus == noErr)
        {
            CheckMenuItem(menuRef,iPlain,(txnContinuousFlags & kTXNStyleContinuousMask) &&
                (txnTypeAttributes.data.dataValue == normal));

            for(menuItem = iBold;menuItem <= iUnderline;menuItem++)
            {
                CheckMenuItem(menuRef,menuItem,(txnContinuousFlags & kTXNStyleContinuousMask) &&
                    (txnTypeAttributes.data.dataValue & (1 << (menuItem - iBold))));
            }
        }
    }
}

// ***** doPrepareColorMenu

void doPrepareColorMenu(MenuRef menuRef,WindowRef windowRef)
{
    TXNObject          txnObject = NULL;
    TXNContinuousFlags txnContinuousFlags = 0;
    TXNTypeAttributes  txnTypeAttributes;
    RGBColor           attributesColor;
    OSStatus           osStatus = noErr;
    SInt16             menuItem;
    RGBColor           itemColors[4] = { { 0xFFFF,0x0000,0x0000 },{ 0x0000,0x8888,0x0000 },
        { 0x0000,0x0000,0xFFFF },{ 0x0000,0x0000,0x0000 } };

```

```

if(isApplicationWindow(windowRef,&txnObject))
{
    txnTypeAttributes.tag          = KTXNQDFontColorAttribute;
    txnTypeAttributes.size         = KTXNQDFontColorAttributeSize;
    txnTypeAttributes.data.dataPtr = &attributesColor;

    osStatus = TXNGetContinuousTypeAttributes(txnObject,&txnContinuousFlags,1,
                                              &txnTypeAttributes);

    if(osStatus == noErr)
    {
        for(menuItem = 1;menuItem < 5;menuItem ++)
        {
            CheckMenuItem(menuRef,menuItem,(txnContinuousFlags & KTXNColorContinuousMask) &&
                          (isEqualRGB(&attributesColor,&itemColors[menuItem - 1])));
        }
    }
}

// ***** isEqualRGB

Boolean isEqualRGB(RGBColor *attributesColor,RGBColor *itemColor)
{
    return (attributesColor->red   == itemColor->red &&
            attributesColor->green == itemColor->green &&
            attributesColor->blue  == itemColor->blue);
}

// ***** doPrepareJustificationMenu

void doPrepareJustificationMenu (MenuRef menuRef,WindowRef windowRef)
{
    TXNObject      txnObject = NULL;
    static UInt32  itemJustifications[6] = { kTXNFlushDefault,kTXNFlushLeft,kTXNFlushRight,
                                              kTXNCenter,kTXNFullJust,kTXNForceFullJust};

    TXNControlTag  txnControlTag[1];
    TXNControlData txnControlData[1];
    SInt16         menuItem;
    OSStatus       osStatus = noErr;

    if(isApplicationWindow(windowRef,&txnObject))
    {
        txnControlTag[0]          = KTXNJustificationTag ;
        txnControlData[0].uValue = 0;

        osStatus = TXNGetTXNObjectControls(txnObject,1,txnControlTag,txnControlData);

        if(osStatus == noErr)
        {
            for(menuItem = iDefault;menuItem <= iForceFull;menuItem ++)
                CheckMenuItem(menuRef,menuItem,(txnControlData[0].uValue ==
                                              itemJustifications[menuItem - 1]));
        }
    }
}

```

```
// ***** doMenuChoice

void doMenuChoice(SInt32 menuChoice)
{
    MenuID      menuID;
    MenuItemIndex menuItem;
    OSStatus     osStatus = noErr;
    WindowRef    windowRef;
    TXNObject     txnObject = NULL;

    windowRef = FrontWindow();

    menuID = HiWord(menuChoice);
    menuItem = LoWord(menuChoice);

    if(menuID == 0)
        return;

    switch(menuID)
    {
        case mAppleApplication:
            if(menuItem == iAbout)
                doAboutDialog();
            break;

        case mFile:
            doFileMenuChoice(menuItem,windowRef);
            break;

        case mEdit:
            doEditMenuChoice(menuItem,windowRef);
            break;

        case mFont:
            doFontMenuChoice(menuID,menuItem,windowRef);
            break;

        case mSize:
            doSizeMenuChoice(menuItem,windowRef);
            break;

        case mStyle:
            doStyleMenuChoice(menuItem,windowRef);
            break;

        case mColor:
            doColorMenuChoice(menuItem,windowRef);
            break;

        case mJustification:
            doJustificationMenuChoice(menuItem,windowRef);
            break;
    }
}
```

```

        default:
            if(menuID >= mFirstHierarchical)
                doFontMenuChoice(menuID,menuItem,windowRef);
            break;
    }

    HiliteMenu(0);
}

// ***** doFileMenuChoice

void doFileMenuChoice(MenuBarItem menuItem,WindowRef windowRef)
{
    TXNObject txnObject = NULL;
    OSStatus osStatus = noErr;

    switch(menuItem)
    {
        case iNew:
            if(osStatus = doNewCommand())
                doErrorAlert(osStatus);
            break;

        case iOpen:
            if(osStatus = doOpenCommand())
                doErrorAlert(osStatus);
            break;

        case iClose:
            if((osStatus = doCloseCommand(kNavSaveChangesClosingDocument)) &&
                osStatus != kNavAskSaveChangesCancel)
                doErrorAlert(osStatus);
            break;

        case iSave:
            if(osStatus = doSaveCommand())
                doErrorAlert(osStatus);
            break;

        case iSaveAs:
            if(osStatus = doSaveAsCommand())
                doErrorAlert(osStatus);
            break;

        case iRevert:
            if(osStatus = doRevertCommand())
                doErrorAlert(osStatus);
            break;

        case iPageSetup:
            if(isApplicationWindow(windowRef,&txnObject))
            {
                osStatus = TXNPageSetup(txnObject);
            }
    }
}

```

```

        if(osStatus != userCanceledErr && osStatus != noErr)
            doErrorAlert(osStatus);
    }
    break;

case iPrint:
    if(isApplicationWindow(windowRef,&txnObject))
    {
        osStatus = TXNPrint(txnObject);
        if(osStatus != userCanceledErr && osStatus != noErr)
            doErrorAlert(osStatus);
    }
    break;

case iQuit:
    if((osStatus = doQuitCommand(kNavSaveChangesQuittingApplication)) &&
        osStatus != kNavAskSaveChangesCancel)
        doErrorAlert(osStatus);

    if(osStatus != kNavAskSaveChangesCancel)
    {
        if(gTXNFontMenuObject != NULL)
        {
            if(osStatus = TXNDisposeFontMenuObject(gTXNFontMenuObject))
                doErrorAlert(osStatus);
        }

        gTXNFontMenuObject = NULL;

        TXNTerminateTextension();
        gDone = true;
    }
    break;
}
}

// ***** doEditMenuChoice *****

void doEditMenuChoice(MenuItemIndex menuItem,WindowRef windowRef)
{
    TXNObject txnObject = NULL;
    OSStatus osStatus = noErr;

    if(isApplicationWindow(windowRef,&txnObject))
    {
        switch(menuItem)
        {
            case iUndo:
                TXNUndo(txnObject);
                break;

            case iRedo:
                TXNRedo(txnObject);
                break;
        }
    }
}

```



```

        case iCut:
            if((osStatus = TXNCut(txnObject)) == noErr)
                TXNConvertToPublicScrap();
            else
                doErrorAlert(osStatus);
            break;

        case iCopy:
            if((osStatus = TXNCopy(txnObject)) == noErr)
                TXNConvertToPublicScrap();
            else
                doErrorAlert(osStatus);
            break;

        case iPaste:
            if(osStatus = TXNPaste(txnObject))
                doErrorAlert(osStatus);
            break;

        case iClear:
            if(osStatus = TXNClear(txnObject))
                doErrorAlert(osStatus);
            break;

        case iSelectAll:
            TXNSelectAll(txnObject);
            break;
    }
}

// ***** doFontMenuChoice

void doFontMenuChoice(MenuID menuID,MenuItemIndex menuItem,WindowRef windowRef)
{
    TXNObject txnObject = NULL;
    OSStatus osStatus = noErr;

    if(isApplicationWindow(windowRef,&txnObject))
    {
        if(gTXNFontMenuObject != NULL)
        {
            if(osStatus = TXNDoFontMenuSelection(txnObject,gTXNFontMenuObject,menuID,menuItem))
                doErrorAlert(osStatus);
        }
    }
}

```

```
// ***** doSizeMenuChoice
```

```
void doSizeMenuChoice(MenuItemIndex menuItem, WindowRef windowRef)
{
    TXNObject      txnObject = NULL;
    static Fixed    itemSizes[8] = { 0x00090000, 0x000A0000, 0x000B0000, 0x000C0000,
                                     0x000E0000, 0x00120000, 0x00180000, 0x00240000 };

    Fixed          sizeToSet;
    TXNTypeAttributes txnTypeAttributes;
    OSStatus        osStatus = noErr;

    if(isApplicationWindow(windowRef, &txnObject))
    {
        sizeToSet = itemSizes[menuItem - 1];

        txnTypeAttributes.tag      = kTXNQDFontSizeAttribute;
        txnTypeAttributes.size     = kTXNFontSizeAttributeSize;
        txnTypeAttributes.data.dataValue = sizeToSet;

        if(TXNSetTypeAttributes(txnObject, 1, &txnTypeAttributes, kTXNUseCurrentSelection,
                                kTXNUseCurrentSelection))
            doErrorAlert(osStatus);
    }
}
```

```
// ***** doStyleMenuChoice
```

```
void doStyleMenuChoice(MenuItemIndex menuItem, WindowRef windowRef)
{
    TXNObject      txnObject = NULL;
    static Style    itemStyles[5] = { normal, 0, bold, italic, underline };
    Style          styleToSet;
    TXNTypeAttributes txnTypeAttributes;
    OSStatus        osStatus = noErr;

    if(isApplicationWindow(windowRef, &txnObject))
    {
        styleToSet = itemStyles[menuItem - 1];

        txnTypeAttributes.tag      = kTXNQDFontStyleAttribute;
        txnTypeAttributes.size     = kTXNQDFontStyleAttributeSize;
        txnTypeAttributes.data.dataValue = styleToSet;

        if(TXNSetTypeAttributes(txnObject, 1, &txnTypeAttributes, kTXNUseCurrentSelection,
                                kTXNUseCurrentSelection))
            doErrorAlert(osStatus);
    }
}
```

```
// ***** doColorMenuChoice

void doColorMenuChoice(MenuItemIndex menuItem, WindowRef windowRef)
{
    TXNObject      txnObject = NULL;
    Point          where;
    Boolean        colorPickerButton;
    Str255         prompt = "\pPick a text color";
    RGBColor       colorToSet;
    RGBColor       itemColors[4] = { { 0xFFFF, 0x0000, 0x0000 }, { 0x0000, 0x8888, 0x0000 },
                                     { 0x0000, 0x0000, 0xFFFF }, { 0x0000, 0x0000, 0x0000 } };

    TXNTypeAttributes txnTypeAttributes;
    OSStatus         osStatus = noErr;

    if(isApplicationWindow(windowRef, &txnObject))
    {
        if(menuItem == iColorPicker)
        {
            where.v = where.h = 0;
            colorPickerButton = GetColor(where, prompt, &gCurrentColorPickerColor, &colorToSet);
            if(colorPickerButton)
                gCurrentColorPickerColor = colorToSet;
            else
                return;
        }
        else
            colorToSet = itemColors[menuItem - 1];

        txnTypeAttributes.tag      = kTXNQDFontColorAttribute;
        txnTypeAttributes.size     = kTXNQDFontColorAttributeSize;
        txnTypeAttributes.data.dataPtr = &colorToSet;

        if(TXNSetTypeAttributes(txnObject, 1, &txnTypeAttributes, kTXNUseCurrentSelection,
                                kTXNUseCurrentSelection))
            doErrorAlert(osStatus);
    }
}

// ***** doJustificationMenuChoice

void doJustificationMenuChoice(MenuItemIndex menuItem, WindowRef windowRef)
{
    TXNObject      txnObject = NULL;
    static UInt32  itemJustifications[6] = { kTXNFlushDefault, kTXNFlushLeft, kTXNFlushRight,
                                              kTXNCenter, kTXNFullJust, kTXNForceFullJust };

    OSStatus       osStatus = noErr;
    UInt32         justificationToSet;
    TXNControlTag  txnControlTag[1];
    TXNControlData txnControlData[1];

    if(isApplicationWindow(windowRef, &txnObject))
    {
        justificationToSet = itemJustifications[menuItem - 1];
    }
}
```

```

    txnControlTag[0] = kTXNJustificationTag;

    osStatus = TXNGetTXNObjectControls(txnObject, 1, txnControlTag, txnControlData);

    if(txnControlData[0].uValue != justificationToSet)
    {
        txnControlData[0].uValue = justificationToSet;
        osStatus = TXNSetTXNObjectControls(txnObject, false, 1, txnControlTag, txnControlData);
        if(osStatus != noErr)
            doErrorAlert(osStatus);
    }
}
}

// *****
// MLTENewOpenCloseSave.c
// *****

// ..... includes

#include "MLTETextEditor.h"

// ..... global variables

SInt16 gCurrentNumberOfWindows = 0;
SInt16 gUntitledWindowNumber = 0;

extern Boolean gRunningOnX = false;
extern SInt16 gAppResFileRefNum;

// ***** doNewCommand

OSStatus doNewCommand(void)
{
    OSStatus osStatus = noErr;
    WindowRef windowRef;

    if(gCurrentNumberOfWindows == kMaxWindows)
        return eMaxWindows;

    osStatus = doNewDocWindow(&windowRef, NULL, kTXNTextensionFile);

    if(osStatus == noErr)
        SetWindowProxyCreatorAndType(windowRef, kFileCreator, kTXNTextensionFile, kUserDomain);

    return osStatus;
}

```

```
// ***** doOpenCommand

OSStatus doOpenCommand(void)
{
    OSStatus          osStatus = noErr;
    NavDialogOptions  dialogOptions;
    NavTypeListHandle fileTypeListHdl = NULL;
    NavEventUPP       navEventFunctionUPP;
    NavReplyRecord     navReplyStruc;
    SInt32             count, index;
    AEKeyword          theKeyword;
    DescType           actualType;
    FSSpec             fileSpec;
    Size               actualSize;
    FInfo              fileInfo;
    OSType             fileType;

    osStatus = NavGetDefaultDialogOptions(&dialogOptions);

    if(osStatus == noErr)
    {
        GetIndString(dialogOptions.clientName, rMiscellaneousStrings, sApplicationName);
        fileTypeListHdl = (NavTypeListHandle) GetResource('open', rOpenResource);

        navEventFunctionUPP = NewNavEventUPP((NavEventProcPtr) navEventFunction);

        osStatus = NavGetFile(NULL, &navReplyStruc, &dialogOptions, navEventFunctionUPP,
                               NULL, NULL, fileTypeListHdl, NULL);

        DisposeNavEventUPP(navEventFunctionUPP);

        if(osStatus == noErr && navReplyStruc.validRecord)
        {
            osStatus = AECountItems(&(navReplyStruc.selection), &count);
            if(osStatus == noErr)
            {
                for(index=1; index<=count; index++)
                {
                    osStatus = AEGetNthPtr(&(navReplyStruc.selection), index, typeFSS, &theKeyword,
                                             &actualType, &fileSpec, sizeof(fileSpec), &actualSize);

                    if((osStatus = FSpGetFInfo(&fileSpec, &fileInfo)) == noErr)
                    {
                        fileType = fileInfo.fdType;
                        osStatus = doOpenFile(fileSpec, fileType);
                    }
                }
            }

            osStatus = NavDisposeReply(&navReplyStruc);
        }
    }
}
```

```

    if(fileTypeListHdl != NULL)
        ReleaseResource((Handle) fileTypeListHdl);
}

if(osStatus == userCanceledErr)
    osStatus = noErr;

return osStatus;
}

// ***** doCloseCommand

OSStatus doCloseCommand(NavAskSaveChangesAction action)
{
    WindowRef          windowRef;
    TXNObject           txnObject = NULL;
    OSStatus            osStatus = noErr;
    NavDialogOptions    dialogOptions;
    NavAskSaveChangesResult reply = 0;
    NavEventUPP         navEventFunctionUPP;
    Str255              fileName;

    osStatus = NavGetDefaultDialogOptions(&dialogOptions);

    if(osStatus == noErr)
    {
        windowRef = FrontWindow();
        if(isApplicationWindow(windowRef,&txnObject))
        {
            if(TXNGetChangeCount(txnObject))
            {
                GetWTitle(windowRef,fileName);
                BlockMoveData(fileName,dialogOptions.savedFileName,fileName[0] + 1);
                GetIndString(dialogOptions.clientName,rMiscellaneousStrings,sApplicationName);

                navEventFunctionUPP = NewNavEventUPP((NavEventProcPtr) navEventFunction);

                osStatus = NavAskSaveChanges(&dialogOptions,action,&reply,navEventFunctionUPP,0);

                DisposeNavEventUPP(navEventFunctionUPP);
            }

            if(osStatus == noErr)
            {
                switch(reply)
                {
                    case kNavAskSaveChangesSave:
                        if((osStatus = doSaveCommand()) == noErr)
                            doCloseWindow(windowRef,txnObject);
                        break;

                    case kNavAskSaveChangesDontSave:
                        doCloseWindow(windowRef,txnObject);
                        break;
                }
            }
        }
    }
}

```

```

        case kNavAskSaveChangesCancel:
            osStatus = kNavAskSaveChangesCancel;
            break;
    }
}
else
{
    doCloseWindow(windowRef,txnObject);
}
}
}

return osStatus;
}

// ***** doSaveCommand

OSStatus doSaveCommand(void)
{
    WindowRef windowRef;
    OSStatus hasNoFileSpec;
    OSStatus osStatus = noErr;
    FSSpec fileSpec;

    windowRef = FrontWindow();

    hasNoFileSpec = GetWindowProperty(windowRef,kFileCreator,'FiSp',sizeof(FSSpec),NULL,
                                     &fileSpec);

    if(hasNoFileSpec)
        osStatus = doSaveAsCommand();
    else
        osStatus = doWriteFile(windowRef,false);

    if(osStatus == noErr)
        SetWindowModified(windowRef,false);

    return osStatus;
}

// ***** doSaveAsCommand

OSStatus doSaveAsCommand(void)
{
    OSStatus osStatus = noErr;
    NavDialogOptions dialogOptions;
    WindowRef windowRef;
    NavEventUPP navEventFunctionUPP;
    TXNFileType txnFileType;
    NavReplyRecord navReplyStruc;
    AEKeyword theKeyword;
    DescType actualType;
    FSSpec fileSpec;
    Size actualSize;
    AliasHandle aliasHdl;

```

```

osStatus = NavGetDefaultDialogOptions(&dialogOptions);

if(osStatus == noErr)
{
    windowRef = FrontWindow();

    GetWTitle(windowRef,dialogOptions.savedFileName);
    GetIndString(dialogOptions.clientName,rMiscellaneousStrings,sApplicationName);

    navEventFunctionUPP = NewNavEventUPP((NavEventProcPtr) navEventFunction);

    GetWindowProperty(windowRef,kFileCreator,'FiTy',sizeof(TXNFileType),NULL,&txnFileType);

    osStatus = NavPutFile(NULL,&navReplyStruc,&dialogOptions,navEventFunctionUPP,
        txnFileType,kFileCreator,NULL);

    DisposeNavEventUPP(navEventFunctionUPP);

    if(navReplyStruc.validRecord && osStatus == noErr)
    {
        if((osStatus = AEGetNthPtr(&(navReplyStruc.selection),1,typeFSS,&theKeyword,
            &actualType,&fileSpec,sizeof(fileSpec),&actualSize))
            == noErr)
        {
            if(!navReplyStruc.replacing)
            {
                osStatus = FSpCreate(&fileSpec,kFileCreator,txnFileType,navReplyStruc.keyScript);
                if(osStatus != noErr)
                {
                    NavDisposeReply(&navReplyStruc);
                    return osStatus;
                }
            }
        }

        if(osStatus == noErr)
        {
            SetWTitle(windowRef,fileSpec.name);

            SetWindowProperty(windowRef,kFileCreator,'FiSp',sizeof(FSSpec),&fileSpec);
            SetPortWindowPort(windowRef);
            SetWindowProxyFSSpec(windowRef,&fileSpec);
            GetWindowProxyAlias(windowRef,&aliasHdl);
            SetWindowProperty(windowRef,kFileCreator,'tALH',sizeof(AliasHandle),&aliasHdl);
            SetWindowModified(windowRef,false);

            osStatus = doWriteFile(windowRef,!navReplyStruc.replacing);
        }

        NavCompleteSave(&navReplyStruc,kNavTranslateInPlace);
    }

    NavDisposeReply(&navReplyStruc);
}
}

```



```

    if(osStatus == userCanceledErr)
        osStatus = noErr;

    return osStatus;
}

// ***** doRevertCommand

OSStatus doRevertCommand(void)
{
    OSStatus          osStatus = noErr;
    NavDialogOptions  dialogOptions;
    NavEventUPP       navEventFunctionUPP;
    WindowRef         windowRef;
    Str255            fileName;
    NavAskSaveChangesResult reply;
    TXNObject         txnObject = NULL;

    osStatus = NavGetDefaultDialogOptions(&dialogOptions);

    if(osStatus == noErr)
    {
        navEventFunctionUPP = NewNavEventUPP((NavEventProcPtr) navEventFunction);

        windowRef = FrontWindow();
        GetWTitle(windowRef, fileName);
        BlockMoveData(fileName, dialogOptions.savedFileName, fileName[0] + 1);

        osStatus = NavAskDiscardChanges(&dialogOptions, &reply, navEventFunctionUPP, 0);

        DisposeNavEventUPP(navEventFunctionUPP);

        if(osStatus == noErr)
        {
            if(reply == kNavAskDiscardChanges)
            {
                if(isApplicationWindow(windowRef, &txnObject))
                {
                    TXNRevert(txnObject);

                    if(TXNDataSize(txnObject))
                        SetWindowModified(windowRef, false);
                }
            }
        }
    }

    return osStatus;
}

```

```
// ***** doQuitCommand

OSStatus doQuitCommand(NavAskSaveChangesAction action)
{
    OSStatus osStatus = noErr;

    while(FrontWindow())
    {
        osStatus = doCloseCommand(action);
        if(osStatus != noErr)
            return osStatus;
    }

    return osStatus;
}

// ***** doNewDocWindow

OSStatus doNewDocWindow(WindowRef *outWindowRef, FSSpec *fileSpec, TXNFileType txnFileType)
{
    WindowRef      windowRef;
    Str255          numberAsString, titleString = "\puntitled ";
    Rect            availableBoundsRect, portRect;
    SInt16          windowHeight;
    TXNFrameOptions txnFrameOptions;
    OSStatus        osStatus = noErr;
    TXNObject       txnObject = NULL;
    TXNFrameID      txnFrameID;
    RGBColor        frameColor = { 0xEEEE, 0xEEEE, 0xEEEE };
    TXNControlTag   txnControlTag[1];
    TXNControlData  txnControlData[1];
    TXNMargins      txnMargins;
    CGContextRef     cgContextRef;

    // ..... get window

    if(!(windowRef = GetNewCWindow(rNewWindow, NULL, (WindowRef) -1)))
        return MemError();
    SetPortWindowPort(windowRef);

    ChangeWindowAttributes(windowRef, kWindowInWindowMenuAttribute, 0);

    gUntitledWindowNumber++;
    if(gUntitledWindowNumber != 1)
    {
        NumToString(gUntitledWindowNumber, numberAsString);
        doConcatPStrings(titleString, numberAsString);
    }
    SetWTitle(windowRef, titleString);
}
```

```

// ..... extend window bottom to bottom of screen less the dock

GetAvailableWindowPositioningBounds(GetMainDevice(),&availableBoundsRect);
GetWindowPortBounds(windowRef,&portRect);
LocalToGlobal(&topLeft(portRect));
windowHeight = availableBoundsRect.bottom - portRect.top;
SizeWindow(windowRef,630>windowHeight>false);

// ..... get new TXNObject and attach window to it

txnFrameOptions = kTXNWantHScrollBarMask | kTXNWantVScrollBarMask | kTXNShowWindowMask;

osStatus = TXNNewObject(fileSpec>windowRef,NULL,txnFrameOptions,kTXNTextEditStyleFrameType,
                        txnFileType,kTXNSystemDefaultEncoding,&txnObject,&txnFrameID,
                        NULL);

if(osStatus == noErr)
{
    // ..... associate frame ID and TXNObject with window

    SetWindowProperty(windowRef,kFileCreator,'tOBJ',sizeof(TXNObject),&txnObject);
    SetWindowProperty(windowRef,kFileCreator,'tFRM',sizeof(TXNFrameID),&txnFrameID);
    if(fileSpec != NULL)
        SetWindowProperty(windowRef,kFileCreator,'FiSp',sizeof(FSSpec),fileSpec);
    SetWindowProperty(windowRef,kFileCreator,'FiTy',sizeof(TXNFileType),&txnFileType);

    // ..... set margins

    txnControlTag[0] = kTXNMarginsTag;
    txnControlData[0].marginsPtr = &txnMargins;

    txnMargins.leftMargin = txnMargins.topMargin = 10;
    txnMargins.rightMargin = txnMargins.bottomMargin = 10;
    TXNSetTXNObjectControls(txnObject>false,1,txnControlTag,txnControlData);

    // ..... create core graphics context and pass to MLTE

    if(gRunningOnX)
    {
        CreateCGContextForPort(GetWindowPort(windowRef),&cgContextRef);
        txnControlTag[0] = kATSUCGContextTag;
        txnControlData[0].uValue = (UInt32) cgContextRef;
        TXNSetTXNObjectControls(txnObject>false,1,txnControlTag,txnControlData);
    }
}
else
    doErrorAlert(osStatus);

gCurrentNumberOfWindows ++;
if(gCurrentNumberOfWindows == 1)
    doEnableDisableMenus(true);

*outWindowRef = windowRef;

return noErr;
}

```

```
// ***** doOpenFile

OSStatus doOpenFile(FSSpec fileSpec, OSType fileType)
{
    OSStatus    osStatus = noErr;
    WindowRef   windowRef;
    AliasHandle  aliasHdl;

    if (osStatus = doNewDocWindow(&windowRef, &fileSpec, fileType))
        return osStatus;

    SetWindowTitle(windowRef, fileSpec.name);

    SetWindowProxyFSSpec(windowRef, &fileSpec);
    GetWindowProxyAlias(windowRef, &aliasHdl);
    SetWindowProperty(windowRef, kFileCreator, 'tALH', sizeof(AliasHandle), &aliasHdl);

    SetWindowModified(windowRef, false);

    return noErr;
}

// ***** doCloseFile

void doCloseWindow(WindowRef windowRef, TXNObject txnObject)
{
    TXNDeleteObject(txnObject);
    DisposeWindow(windowRef);
    gCurrentNumberOfWindows--;
    if (gCurrentNumberOfWindows == 0)
        doEnableDisableMenus(false);
}

// ***** doWriteFile

OSStatus doWriteFile(WindowRef windowRef, Boolean newFile)
{
    TXNPermanentTextEncodingType encodingType;
    TXNObject    txnObject = NULL;
    FSSpec       fileSpec, fileSpecTemp;
    TXNFileType  txnFileType;
    UInt32       currentTime;
    Str255       tempFileName;
    OSStatus     osStatus = noErr;
    SInt16       tempFileVolNum, tempFileRefNum, tempResForkRefNum = -1;
    SInt32       tempFileDirID;
    Boolean       hasResFile = false;

    GetWindowProperty(windowRef, kFileCreator, 'tOBJ', sizeof(TXNObject), NULL, &txnObject);
    GetWindowProperty(windowRef, kFileCreator, 'FiSp', sizeof(FSSpec), NULL, &fileSpec);
    GetWindowProperty(windowRef, kFileCreator, 'FiTy', sizeof(TXNFileType), NULL, &txnFileType);

    encodingType = (txnFileType == kTXNTextFile) ? kTXNMacOSEncoding : kTXNUnicodeEncoding;
```

```

    GetDateTime(&currentTime);
    NumToString((SInt32) currentTime, tempFileName);

    osStatus = FindFolder(fileSpec.vRefNum, kTemporaryFolderType, kCreateFolder, &tempFileVolNum,
                        &tempFileDirID);
    if(osStatus == noErr)
        osStatus = FSMakeFSSpec(tempFileVolNum, tempFileDirID, tempFileName, &fileSpecTemp);
    if(osStatus == noErr || osStatus == fnfErr)
        osStatus = FSpCreate(&fileSpecTemp, 'trsh', 'trsh', smSystemScript);
    if(osStatus == noErr)
        osStatus = FSpOpenDF(&fileSpecTemp, fsRdWrPerm, &tempFileRefNum);

    if(osStatus == noErr)
    {
        if(txnFileType == kTXNTextFile)
        {
            FSpCreateResFile(&fileSpecTemp, 'trsh', 'trsh', smSystemScript);
            osStatus = ResError();
            if(osStatus == noErr)
                tempResForkRefNum = FSpOpenResFile(&fileSpecTemp, fsRdWrPerm);
            hasResFile = true;
        }
    }

    if(osStatus == noErr)
        osStatus = TXNSave(txnObject, txnFileType, kTXNMultipleStylesPerTextDocumentResType,
                        encodingType, &fileSpec, tempFileRefNum, tempResForkRefNum);

    if(osStatus == noErr)
        osStatus = FSpExchangeFiles(&fileSpecTemp, &fileSpec);
    if(osStatus == noErr)
        osStatus = FSpDelete(&fileSpecTemp);

    if(osStatus == noErr)
        osStatus = FSClose(tempFileRefNum);
    if(osStatus == noErr)
        if(tempResForkRefNum != -1)
            CloseResFile(tempResForkRefNum);

    osStatus = ResError();

    if(osStatus == noErr)
        if(newFile)
            osStatus = doCopyResources(fileSpec, txnFileType, hasResFile);

    return osStatus;
}

```

```
// ***** doCopyResources
```

```
OSStatus doCopyResources(FSSpec fileSpec, TXNFileType fileType, Boolean hasResFile)
```

```
{
    OSStatus osStatus = noErr;
    SInt16 fileRefNum;

    if(!hasResFile)
        FSpCreateResFile(&fileSpec, kFileCreator, fileType, smSystemScript);

    osStatus = ResError();
    if(osStatus == noErr)
        fileRefNum = FSpOpenResFile(&fileSpec, fsRdWrPerm);

    if(fileRefNum > 0)
        osStatus = doCopyAResource('STR ', -16396, gAppResFileRefNum, fileRefNum);
    else
        osStatus = ResError();

    if(osStatus == noErr)
        CloseResFile(fileRefNum);

    osStatus = ResError();

    return osStatus;
}
```

```
// ***** doCopyAResource
```

```
OSStatus doCopyAResource(ResType resourceType, SInt16 resourceID, SInt16 sourceFileRefNum,
                        SInt16 destFileRefNum)
```

```
{
    Handle sourceResourceHdl;
    Str255 sourceResourceName;
    ResType ignoredType;
    SInt16 ignoredID;

    UseResFile(sourceFileRefNum);

    sourceResourceHdl = GetResource(resourceType, resourceID);

    if(sourceResourceHdl != NULL)
    {
        GetResInfo(sourceResourceHdl, &ignoredID, &ignoredType, sourceResourceName);
        DetachResource(sourceResourceHdl);
        UseResFile(destFileRefNum);
        AddResource(sourceResourceHdl, resourceType, resourceID, sourceResourceName);
        if(ResError() == noErr)
            UpdateResFile(destFileRefNum);
    }

    ReleaseResource(sourceResourceHdl);

    return ResError();
}
```

```
// ***** navEventFunction

void navEventFunction(NavEventCallbackMessage callBackSelector, NavCBRecPtr callBackParms,
                     NavCallBackUserData callBackUD)
{
    WindowRef windowRef;

    switch(callBackSelector)
    {
        case kNavCBEvt:
            switch(callBackParms->eventData.eventDataParms.event->what)
            {
                case updateEvt:
                    windowRef = (WindowRef) callBackParms->eventData.eventDataParms.event->message;
                    if(GetWindowKind(windowRef) != kDialogWindowKind)
                        doUpdate((EventRecord *) callBackParms->eventData.eventDataParms.event);
                    break;
            }
            break;
    }
}

// *****
```

## Demonstration Program MLTETextEditor Comments

This program, like all previous programs, demonstrates the programming of one particular aspect of the Mac OS. However, unlike all previous demonstration programs, it can also be used as a useful application, that is, as a fully functional basic text editor.

New documents created by the text editor are created and saved as Textension ('txtn') file types. Existing files of type 'TEXT' and Unicode ('utxt') can be opened and saved as 'TEXT' and Unicode files. For 'TEXT' files, style information is saved in 'styl1' resources. Movies may be embedded within documents.

Those areas of the program relating to file operations and window proxy icons follow the same general approach as does the demonstration program files (see Chapter 18). This includes the file synchronization function and the functions for copying the missing application name string resource to the resource fork of saved files. The Apple event handlers are identical to those in the demonstration program files, except for the added capability to handle the Print Documents event.

## MLTETextEditor.c

### Main

The application's resource fork file reference number is saved for use in the function `doCopyResources`.

`CreateStandardWindowMenu` is used to create a Window menu, which is then given an ID and added to the menu list. If the program is running on Mac OS 8/9, the first item in the Window menu (Zoom Window) is deleted. (As will be seen in this program, `TXNZoomWindow` is called when the user clicks the zoom box/button. `TXNZoomWindow` adjusts the scroll bars automatically; however, this does not occur when Zoom Window is chosen from a Window menu. It is thus necessary to delete the item in this particular program.)

After a reference to the Font menu is obtained, `TXNNewFontMenuObject` is called to create a hierarchical Font menu. Note that the value passed in the third parameter, which specifies the ID of the first sub-menu, must be 160 or higher.

### doInitializeMLTE

`doInitializeMLTE` is called from `doPreliminaries`. The call to `TXNInitTextension` initializes the Textension library. Font information specifying that the default font, font size, and font style for the system default encoding (Unicode on systems with ATSUI) be New York, 12 point, normal is passed in the first parameter. The encoding field specifies how the application wants to see text. The third parameter specifies that embedded movies are to be supported.

### doInstallAEHandlers

Note that `openAndPrintDocsEventHandler` will be called when both an Open Documents and a Print Documents event is received, the difference being that the reference constant is set to `kOpen` (0) for an Open Application event and to `kPrint` (1) for a Print Documents event.

### eventLoop

Note that the value passed in `WaitNextEvent`'s sleep parameter is the value returned by a call to the function `doGetSleepTime`. Note also that, when a NULL event is returned by `WaitNextEvent`, the functions `doIdle` and `doSynchroniseFiles` are called.

### doGetSleepTime

`doGetSleepTime` determines the value passed in `WaitNextEvent`'s sleep parameter.

This is the first of many functions that call the function `isApplicationWindow`. As will be seen, `isApplicationWindow` returns true if there is an open window and if it is of the application kind. It also returns, in the `txnObject` parameter, the `TXNObject` to which the window was attached when the window was created.



If there is an open window, and if it is of the application kind, `TXNGetSleepTicks` is called to get the sleep time to be passed to `WaitNextEvent`. This ensures that the function `doIdle` will be called at the appropriate interval. If the front window is of the dialog kind, the sleep time is set to the value returned by a call to `GetCaretTime`. (Actually, in this application, which presents no dialogs with edit text items, it might be considered more appropriate to set the sleep time to the maximum unsigned long value at the `else` statement.)

### **doIdle**

`doIdle` is called to perform idle processing.

The call to `TXNGetChangeCount` gets the number of times the document has been changed since the last time the `TXNObject` was saved. If any changes have been made since the last save, `SetWindowModified` is called to disable the window proxy icon.

### **doEvents**

At the `keyDown` case, note that `TXNKeyDown` does not need to be called in a Carbon application. Carbon special-cases Command-key events to avoid them being sent to MLTE. However, all other key-downs get sent directly to the Type Services Manager and your application never gets to “see” them. This means that, in Carbon applications, you cannot filter out characters for special handling before they are passed to MLTE (`TXNKeyDown`) as you could in a Classic application.

The only exception is Command-key events. For command keys, because MLTE has the habit of eating all keystrokes that go to it, even command keys that it can’t process, we detect if the command key exists in the menus and special-case it to avoid sending it to MLTE.

At the `mouseMovedMessage` case within the `osEvt` case, `TXNAdjustCursor` is called to handle cursor shape changing. If the mouse is over a text area, `TXNAdjustCursor` sets the cursor to the I-beam cursor. If the cursor is over a movie, over a scroll bar, or outside a text area, `TXNAdjustCursor` sets the cursor to the arrow cursor.

### **doMouseDown**

At the `inGrow` case, `TXNGrowWindow` is called to handle the resizing operation. At the `inZoomIn/inZoomOut` case, `TXNZoomWindow` is called to zoom the window. At the `inDrag`, `inGrow`, and `inZoomIn/inZoomOut` cases, `TXNAdjustCursor` is called after the window has been dragged, re-sized, or zoomed so that the mouse-moved region is re-calculated.

### **doActivate**

As will be seen, when `TXNObject` is created and a window attached to it, `SetWindowProperty` is called to associate the `TXNObject` frame ID with the window. The call to `GetWindowProperty` retrieves this frame ID.

If the window is becoming active, `TXNActivate` is called, with `true` passed in the third parameter, to activate the scroll bars. Also, `TXNFocus` is called, with `true` passed in the second parameter to activate text input (selection and typing). If the window is becoming inactive, `false` is passed in `TXNActivate`'s third parameter and `TXNFocus`'s second parameter to deactivate the scroll bars and text input.

### **doUpdate**

`TXNUpdate` is called to redraw everything in the content area. Note that this function calls `BeginUpdate` and `EndUpdate`, so it is not necessary for the application to do so.

### **isApplicationWindow**

`isApplicationWindow` is called from many functions. It returns `true` if there is a front window and if that window is of the application kind. It also returns to the caller the `TXNObject` to which that window is attached. As will be seen, the `TXNObject` is associated with the window when both are created, and is retrieved here by the call to `GetWindowProperty`.

### **doSynchroniseFiles**

`doSynchroniseFiles` is the file synchronization function (see Chapter 18). It is adapted from the function of the same name in the demonstration program files. In this version

- The method used to determine whether the window has a file associated with it is to call `GetWindowProperty` in an attempt to retrieve the handle to the alias structure which, as will be seen, is associated with a window by a call to `SetWindowProperty` when a file is saved or loaded.
- If the `aliasChanged` parameter is set to `true` in the call to `ResolveAlias`, meaning that the location of the file has changed, the file system specification structure returned by `ResolveAlias` is associated with the window by the call to `SetWindowProperty`, replacing the previous file system specification structure stored in the window.
- At the inner `if` statement, if the file is found to be in the trash, `GetWindowProperty` is called to return the `TXNObject` associated with the window when it was created, `TXNDeleteObject` is called to delete the `TXNObject` and its associated data structures, and `DisposeWindow` is called to dispose of the window.

### **openAndPrintDocsEventHandler**

`openAndPrintDocsEventHandler` is called when an Open Documents or Print Documents Apple event is received. In both cases, `doOpenFile` is called to open and display the file. In the case of a Print Documents event, `TXNPrint` is also called to print the document, following which `doCloseCommand` is called to dispose of the window and its `TXNObject`.

**doErrorAlert**

If the error code is `KATSUFontsMatched` (–8793), `doErrorAlert` simply returns. `KATSUFontsMatched` is not an error as such, but is returned by `ATSUMatchFontsToText` when changes need to be made to the fonts associated with the text.

**MLTEMenus.c****doEnableDisableMenus**

`doEnableDisableMenus` is called from `doCloseWindow` and `doNewDocWindow` to ensure that all menus except the File menu are disabled if no windows are open and that those menus are enabled if at least one window is open.

**doAdjustFileMenu**

If the call to `TXNGetChangeCount` reveals that the document has been changed since it was opened or last saved, the File menu Save and Revert items are enabled, otherwise they are disabled.

If the call to `TXNDataSize` reveals that there are characters in the `TXNObject`, the Save As, Page Setup, and Print items are enabled, otherwise they are disabled.

The else block executes only if no windows are open, ensuring that all File menu items except New, Open, and Quit are disabled.

**doEditMenu**

At the first block, all Edit menu items are disabled. At the second block, the default item text for both the Undo and Redo items (Can't Undo, Can't Redo) is set. This may be changed by the next two blocks.

The next block addresses the Undo item. The call to `TXNCanUndo` determines whether the last action is undoable. If the last action is undoable, `TXNCanUndo` returns, in the second parameter, an action key code that will be used to index a `STR#` resource for a string describing the undoable action. If this action key code represents a typing, cut, paste, clear, change font, change font color, change font size, change font style, change alignment, drag action, or move action, the appropriate string is retrieved by the call to `GetIndString` and the item text is set to this string (for example, Undo Cut). If the action is any other action, the item text is set to Undo.

At the block beginning with the call to `TXNCanRedo`, the same process is repeated in respect of the Redo item.

If the call to `TXNIsEmptySelection` reveals that the current selection is not empty, the Cut, Copy, and Clear items are enabled.

If the call to `TXNIsScrapPastable` reveals that the current scrap contains data that is supported by MLTE, the Paste item is enabled.

If the call to `TXNDataSize` reveals that there are characters in the `TXNObject`, the Select All item is enabled.

### **doPrepareFontMenu**

`doAdjustFileMenu` and `doAdjustEditMenu` are concerned with enabling and disabling menu items as appropriate. `doPrepareFontMenu` and the other menu preparation functions are concerned with adding and removing checkmarks from items.

For the Font menu, all that is required is a call to `TXNPrepareFontMenu`. If the insertion point caret is in text in a particular font, or if a selection contains text in a single font, that menu item will be checkmarked. (If the font is in a Font menu sub-menu, the item in the sub-menu is checkmarked and a “dash” marking character is placed in the Font menu item to which the sub-menu is attached.) On the other hand, if a selection contains text in more than one font, all marking characters are removed from the Font menu and its sub-menus.

### **doPrepareSizeMenu**

`doPrepareSizeMenu` does for the Size menu what `doPrepareFontMenu` does for the Font menu. If the insertion point caret is in text in a particular size, or if a selection contains text in a single size, the associated Size menu item is checkmarked. On the other hand, if a selection contains text in more than one size, all Size menu items are un-checkmarked.

Font size is represented by a value of type `Fixed` (four bytes comprising 16-bit signed integer plus 16-bit fraction). Accordingly, the `itemSizes` array is initialized with the sizes represented in the Size menu (9, 10, 11, 12, 14, 18, 24, 36) expressed as `Fixed` values. Each element in the array corresponds to an individual menu item.

The tag and size fields of a structure of type `TXNTypeAttributes` are assigned, respectively, a value (‘size’) specifying the size attribute and the size of the `Fixed` data type. The call to `TXNGetContinuousTypeAttributes` tests the current selection to see if the font size is continuous. On output, bit 1 in the second parameter (`txContinuousFlags`) will be set if all the text in the selection is all of one size, and the `dataValue` field of the data field of `txnTypeAttributes` will contain that size.

All items in the menu are then walked. If bit 1 of `txContinuousFlags` is not set, all items will be un-checkmarked. If bit 1 is set, and if the font size returned in the `dataValue` field is equal to the value in that element of the `itemSizes` array corresponding to the current menu item, that item is checkmarked, otherwise it is uncheckmarked.

### **doPrepareStyleMenu**

The same general approach is used to prepare the Style menu. In this case, the tag and size fields of a structure of type `TXNTypeAttributes` are assigned, respectively, a value ('face') specifying the style attribute and the size of the Style data type. Also, the block that checkmarks or un-checkmarks the menu items is a little different, reflecting the fact that the bold, italic, and underline styles can be cumulative.

The first call to `CheckMenuItem` checkmarks the Plain menu item if all the text in the selection is of the same style and if that style is the plain (normal) style. The for loop addresses the bold, italic, and underline menu items only. If all the text in the selection is of the same style, or combination of styles, the menu item/s corresponding to the bits set in the `dataValue` field of the data field of `txnTypeAttributes` are checkmarked, otherwise, they are uncheckmarked.

### **doPrepareColorMenu**

`doPrepareColorMenu` is similar to `doAdjustSizeMenu` except that the tag and size fields of a structure of type `TXNTypeAttributes` are assigned, respectively, a value ('klor') specifying the color attribute and the size of the `RGBColor` data type. Note also that the address of the `attributesColor` variable is assigned to the `dataPtr` field of the data field of `txnTypeAttributes`, meaning that `attributesColor` receives the color returned by the call to `TXNGetContinuousTypeAttributes`. It is the color stored in `attributesColor` that is compared with the colors stored in the `itemColors` array in order to determine whether a menu item should be checked or unchecked (assuming that the selection contains text in one color only).

### **doPrepareJustificationMenu**

In `doPrepareJustificationMenu`, the first element of a single-element array of type `TXNControl` is assigned the control tag 'just'. The call to `TXNGetTXNObjectControls` returns, in the `uValue` field of the first element of a single-element array of type `TXNControlData`, a value representing the current justification setting in the `TXNObject`. This value determines which item in the Justification menu is checkmarked, all other items being uncheckmarked.

### **doFileMenuChoice**

`doFileMenuChoice` is broadly similar to the function of the same name in the demonstration program `Files`, except as follows.

At the `iPageSetup` case, `TXNPageSetup` is called. `TXNPageSetup` displays the Page Setup dialog and handles all text re-formatting arising from user interaction with the dialog.

At the `iPrint` case, `TXNPrint` is called. `TXNPrint` displays the Print dialog and prints the document.

At the `iQuit` case, if close-down has not been interrupted by the user clicking in the Cancel button of a Save Changes dialog, `TXNDisposeFontMenuObject` is called to dispose of the `TXNFontMenuObject` created at program start. Note that, even if the object is successfully disposed of, it is still necessary to set the associated global variable to `NULL`.

### **doEditMenuChoice**

At the `iUndo` and `iRedo` cases, `TXNUndo` and `TXNRedo` are called to undo and redo the last action.

At the `iCut` and `iCopy` cases, `TXNCut` and `TXNCopy` are called to cut and copy the current selection to MLTE's private scrap. `TXNConvertToPublicScrap` is also called to copy MLTE's private scrap to the public scrap (clipboard). Note that, for reasons explained in Chapter 20, `TXNConvertToPublicScrap` must not be called at a suspend event in a Carbon application.

At the `iPaste` case, `TXNPaste` is called to paste MLTE's private scrap to the document. Note that there is no need to precede this call with a call to `TXNConvertFromPublicScrap` in a Carbon application. In a Carbon application, MLTE keeps the public scrap (clipboard) synchronized with MLTE's private scrap.

At the `iClear` case, `TXNClear` is called to delete the current selection without copying it to the MLTE private scrap. At the `iSelectAll` case, `TXNSelectAll` is called to select everything in the frame.

### **doFontMenuChoice**

`doFontMenuChoice` handles choices from the Font menu. The call to `TXNFontMenuSelection` takes a menu ID and menu item index and changes the current selection to the font represented by that menu item.

### **doSizeMenuChoice**

`doSizeMenuChoice` handles choices from the Size menu. The received menu item index is used to determine which element of the `itemSizes` array is assigned to the variable `sizeToSet`. The tag and size fields of a structure of type `TXNTypeAttributes` are then assigned, respectively, a value ('size') specifying the size attribute and the size of the Fixed data type. The `dataValue` field of the data field is assigned the size to set. The call to `TXNSetTypeAttributes` sets the font size in the specified `TXNObject`.

### **doStyleMenuChoice and doColorMenuChoice**

`doStyleMenuChoice` and `doColorMenuChoice` handle choices from the Style and Color menus, and use the same general approach as `doSizeMenuChoice`. The exception is that, in `doColorMenuChoice`, if the Color Picker item is chosen, `GetColor` is called to present the Color Picker dialog to solicit a color choice by the user.

### **doJustificationMenuChoice**

`doJustificationMenuChoice` handles choices from the Justification menu. The received menu item index is used to determine which element of the `itemJustification` array is assigned to the variable `justificationToSet`. The single element of an array of type `TXNControlItemTag` is then assigned a value ('just') specifying the justification tag. The call to `TXNGetTXNObjectControls` returns, in the fourth parameter, the `TXNObject`'s current justification setting. If this setting is not the same as the justification the user is attempting to set, `TXNSetTXNObjectControls` is called to set the chosen justification in the `TXNObject` `false` is passed in the second parameter so that all controls are not reset to the defaults.

## **MLTENewOpenCloseSave.c**

The file handling functions in this section are broadly similar to those in the demonstration program files. This includes those areas of the code relating to window proxy icons. Generally, only the code that differs from the files code is explained in the following.

Fig 1 shows the general File menu and Apple event handling strategy, as adapted from Fig 4 in Chapter 18.

### **doNewCommand**

`doNewCommand` is called when the user chooses New from the File menu, and from the Open Application and Re-Open Application Apple Event handlers.

If the call to `doNewDocWindow`, a reference to the created window will be returned in the first parameter, `NULL` is passed in the second (file system specification) parameter, and the third parameter specifies the required file type as `Textension`. (Note: If you prefer the file type for documents created by the program to be `TEXT` or `Unicode`, the only actions required are to pass `kTXNTextFile` or `kTXNUnicodeTextFile` in the third parameter of the calls to `doNewDocWindow` and `SetWindowProxyCreatorAndType`.)

### **doOpenCommand**

`doOpenCommand` is called when the user chooses Open from the File menu. Recall that the aim is to get the file system specification and file type for the file, or files, selected in the Navigation Services Open dialog and pass them in a call to `doOpenFile`.

### **doCloseCommand**

`doCloseCommand` is called when the user chooses Close from the File menu, when the user clicks the go-away box of a window, and for each open window when the user chooses Quit from the File menu or the Quit Application Apple event handler is invoked.



if the call to `TXNGetChangeCount` reveals that no changes have been made to the document since it was opened, or since the last save, `doCloseWindow` is called. If changes have been made, a Navigation Services Save Changes dialog box is presented. If the user clicks the Save button, `doSaveCommand` and then `doCloseWindow` are called. If the user clicks the Don't Save button, `doCloseWindow` is called. If the user clicks the Cancel button, that fact is simply reported to the calling function and no other action is taken.

### **doSaveCommand**

`doSaveCommand` is called when the user chooses Save from the File menu and by `doCloseCommand` if the user clicks the Save button in the Save Changes dialog box.

As will be seen, a file system specification is only associated with a window when an existing document is opened or a new document is saved. Thus the call to `GetWindowProperty` will return `false` if a new document has not yet been saved. In this case, `doSaveAsCommand` is called to solicit a filename from the user and then save the document to that file by calling `doWriteFile`. If a file system specification is already associated with the window, the call to `doSaveAsCommand` is bypassed and `doWriteFile` is called to save the file to the existing filename.

### **doSaveAsCommand**

`doSaveAsCommand` is called when the user chooses Save As from the File menu and from `doSaveCommand` when the front window does not yet have a file associated with it.

As will be seen, the file type is associated with the window when the window is created. The call to `GetWindowProperty` retrieves the file type so that it can be passed in the fifth parameter of the call to `NavPutFile` and, if the file is not being replaced, in the third parameter of the call to `FSpCreate`.

The two calls to `SetWindowProperty` associates the file system specification returned by `AEGetNthPtr`, and a handle to the alias data for the file returned by the call to `GetWindowProxyAlias`, with the window. (The latter is used by the file synchronization function.)

The call to `doWriteFile` writes the file.

### **doRevertCommand**

If, when the Discard Changes dialog box is presented, the user clicks the OK button, `TXNRevert` is called to revert to the last saved version of the document or, if the file was not previously saved, to revert to an empty document. The call to `TXNDataSize` determines whether the revert has been to an empty document. If not, `SetWindowModified` is called with `false` passed in the modified parameter to cause the window proxy icon to appear in the enabled state, indicating no unsaved changes.



### **doQuitCommand**

`doQuitCommand` is called when the user chooses Quit from the File menu. For each open window, `doCloseCommand` is called.

### **doNewDocWindow**

`doNewDocWindow` creates a new window, creates a new `TXNObject` and attaches the window to it, associates certain information with the window, sets the background to a light grey color (for demonstration purposes), and sets the margins.

`GetNewCWindow` creates a new invisible window and `SetPortWindowPort` makes its graphics port the current port. The call to `ChangeWindowAttributes` ensures that the window's title will appear as an item in the Window menu.

The next block adjusts the height of the (invisible) window so that the bottom is just above the space occupied by the Mac OS 8/9 control strip.

Preparatory to the call to `TXNNewObject`, a variable of type `TXNFrameOptions` is assigned a value that will specify that the created `TXNObject` is to support horizontal and vertical scroll bars and that the window should be displayed before the call to `TXNNewObject` returns.

The call to `TXNNewObject` creates a new `TXNObject` and attaches it to the window specified in the second parameter. `NULL` is passed in the third (`iFrame`) parameter, meaning that the window's port rectangle will be used as the frame. Note that `kTXNTextensionFile` will be passed in the sixth (`iFileType`) parameter if a new document is being created, and that `kTXNTextFile` or `kTXNUnicodeTextFile` will be passed in if a 'TEXT' or Unicode file is being opened. Note also that the local variable `txnFrameID` will contain the frame ID when `TXNNewObject` returns.

If a pointer to file system specification structure is passed in `TXNNewObject`'s first parameter, `TXNNewObject` will read in the file and display its contents. If `NULL` is passed in this parameter, the document will start empty. (Recall that `NULL` will be received in the `fileSpec` formal parameter when `doNewDocWindow` is called from `doNewCommand`, and a pointer to a file system specification structure will be received when `doNewDocWindow` is called from `doOpenFile`.)

The next block associates the `TXNObject`, the frame ID, and the received file system specification (if any) and file type with the window.

The next block sets the margins to 10 pixels all round. The first element of a single-element array of type `TXNControlTag` is assigned a value ('marg') specifying the margins tag, and the `marginsPtr` field in the first element a single-element array of type `TXNControlData` is assigned the address of a local variable of type `TXNMargins`. The four fields of the `TXNMargins` structure are then assigned the value 10. The call to `TXNSetTXNObjectControls` sets the margins.

By default, MLTE renders text via QuickDraw on Mac OS X. The appearance of text on Mac OS X is greatly enhanced by rendering via Core Graphics. Accordingly, a Core Graphics

context is created and the information is passed to MLTE by calling `TXNSetTXNObjectControls` with the `kATSUGCContextTag`.

If the window and `TXNObject` were successfully created, the global variable that keeps track of the number of open windows is incremented. If the previous number of open windows was zero, meaning that all of the applications menus less the Apple/Application and File menus would have been disabled, `doEnableDisableMenus` is called to enable those menus.

### **doOpenFile**

`doOpenFile` is called from `doOpenCommand` and from the Open Documents Apple event handler. The received file specification structure and file type are passed in a call to `doNewDocWindow` to open a window and create a `TXNObject`. Since the file system specification structure will be passed in the call to `TXNNewObject` in `doNewDocWindow`, `TXNNewObject` will read in the file and display its contents.

### **doCloseWindow**

When `doCloseWindow` is closed to close a window, `TXNDeleteObject` is called to delete the `TXNObject` and all associated data structures. The window is then disposed of, and the global variable, which keeps track of the number of open windows, is decremented. If no windows remain open, `doEnableDisableMenus` is called to disable all of the applications windows less the Apple/Application and File menus.

### **doWriteFile**

`doWriteFile` is called by `doSaveCommand` and `doSaveAsCommand`. As in the demonstration program Files, a “safe save” procedure is used to save files.

The three calls to `GetWindowProperty` retrieve the `TXNObject`, file system specification, and file type stored in the window object. At the next line, the encoding is set to Mac OS Encoding if the file type is ‘TEXT’, otherwise encoding is set to Unicode.

After the temporary file is created and its data fork is opened, and if the file type is of type ‘TEXT’, the resource fork is also created and opened.

The call to `TXNSave` then writes the contents of the document to the temporary file. Note that the file type is passed in the second parameter. If the file is of type ‘TEXT’, `kTXNMultipleStylesPerTextDocumentResType` passed in the third parameter ensures that style information will be saved to the resource fork as a ‘styl’ resource.

The call to `FSpExchangeFiles`, swaps the files’ data by changing the information in the volume’s catalog. The temporary file is then deleted, following which the file’s data and resource forks are closed.

If this is a new file, `doCopyResources` is called to copy the missing application name string resource from the resource fork of the application file to the resource fork of the new file.



# INDEX

**68LC040 emulator, 213**

## A

**About command (Mac OS X), 115**

**access mode, file. See files, access mode**

**accessor functions**

control objects and, 266-267

dialog objects, 350

graphics ports, 499-502

ListRec structure, 1245-1247

PMPageFormat objects, 801-802

PMPrintSettings objects, 803-804

region objects, 534-535

window objects and, 170-171

**action functions**

Controls1 demonstration program, 320-323

Controls2 demonstration program, 336-338

defined, 320

**action key, 1453**

**actionFunction, 1217-1218**

**actionFunctionHoriz, 321**

**actionFunctionLive, 337-338**

**actionFunctionNonLive, 336-337**

**actionFunctionVert, 320-321**

**actions, undoable and re-doable (MLTE),  
1443**

**activate events, 58-59, 1147**

defined, 43

in a list, 1251

in windows, 180

**active device, 1406**

**active windows, 157-158**

**address descriptor structures, 461**

**advance width, 1137**

**AE structure, 462-463**

**AEIMP (InterProcess Messaging Protocol ), 456**

**alert levels, 340-341**

**alerts and dialogs**

accessing menus from, 116

events, 61-62

icons in, 615-616

*See also* dialogs and alerts

**alerts and dialogs events, 61-62**

**alerts windows**

modal, 164

types, 160

**algorithms**

anchor, 1242

cell-selection, 1240-1241

**alias structure, 466**

**aliases, 451, 463**

**alignment and placement constants, 668-670**

**alignment parameters, icon, 617-618**

**alignment, text, 1142**

**allocation blocks, 949-950**

**anchor algorithms, 1242**

**animated cursors**

Mac OS 8/9

constants, 612

creating, 613

custom 'acur' and 'CURS' resources, 612-613

system 'acur' and 'CURS' resources, 612

Mac OS X, 613

**animation, transitional window, 854**

**APIs (Application Program Interface), 1413**

**Appearance demonstration program**

code listing, 231-242

comments, 242-246

*doActivateWindow*, 244

*doChangeKeyBoard Focus*, 246

*doDrawAppearance Primitives*, 244

*doDrawListViewOn9*, 245

*doDrawThemeCompliant TextOn9*, 244-245

*doDrawThemeTextOnX*, 245-246

*doEvents*, 243

*doGetDepthAndDevice*, 246

*doUpdate*, 244

*Global Variables*, 242-243

*Main*, 243

**Appearance Manager, 220-246**

Appearance demonstration program

code listing, 231-242

comments, 242-246

Appearance primitives

*Aqua "look"*, 225

*brush type constants*, 226

*colors and patterns*, 223

*draw state constants*, 224-225

*drawing functions*, 223-224

*drawing in colors and patterns*, 225-227

*Platinum appearance*, 225

*text color constants*, 227

Apple events, 228

background, 220-222

cursors

constants, data types, and functions, 624  
setting functions, 228

data types, 558

functions, 558

graphics ports drawing state, 228

Main Appearance Manager

constants, 229-230

data types, 230

functions, 230-231

menu bar height, 228

new definition functions (Mac OS 8/9), 222

text, 227

themes, 221-222

**appearance suite, 457**

**append method constants, 361-362**

**appEventHandler**

CarbonEvents2 demonstration program, 939-940

CarbonScrap demonstration program, 1126

Miscellany demonstration program, 1436

MoreResources demonstration program, 1084

**Apple event handler, 465-466**

**Apple event structure, 463**



**Apple events, 456-494, 954**

Appearance Manager, 228

Apple event handler,  
465-466

AppleEvents demonstra-  
tion program

*code listing, 472-487*

*comments, 487-494*

attributes and parameters,  
457-460

basics, 456-457

Carbon Event Manager  
and, 901

class, 458

complete event, example  
of, 464

data structure within,  
460-464

*descriptor lists,*

*462-463*

*descriptor structures,*

*460-463, 467*

extracting and checking  
data, 466-467

Finder and, 428

IDs, 458-459

InterProcess Messaging  
Protocol (AEIMP), 456

Main Apple Event

Manager

*constants, 470-471*

*data types, 471*

*functions, 471-472*

Open Documents, 459-460,  
464

required action, 467-470

required suite, 456-457

**Apple Events, Scripting  
and, 4****Apple Help (Mac OS 8/9),  
86****Apple menus (Mac OS  
8/9), 84-85, 114-115****Apple Standard Roman  
character set, 1135****Apple Type Services for  
Unicode Imaging  
(ATSUI), 1442****AppleEvents demonstra-  
tion program**

*code listing, 472-487*

*comments, 487-494*

*doEvents, 490*

*doHasGotRequired*

*Params, 493*

*doInstallAEHandlers,*  
490

*doInstallAnAEHandler,*  
490

*doNewWindow, 494*

*doOpenAppEvent, 490*

*doOpenDocsEvent,*

*491-492*

*doOpenFile, 493*

*doPrepareToTerminate,*  
494

*doPrintDocsEvent, 492*

*doPrintFile, 493-494*

*doQuitAppEvent, 492*

*doReopenAppEvent,*  
491

*doSmallSysFontChange*  
*Event, 492*

*doSysFontChangeEvent,*  
492

*doViewsFontChangeEv*  
*ent, 492*

*Global Variables, 489*

*Main, 490*

*'plst' resource, 488-489*

*showPreferenceEvent*  
*Handler, 492*

**application-defined**

functions, 979-980

object filtering, 979-980

previews, 980

**application event handler,  
standard, 894****Application menus**

Mac OS 8/9, 86

Mac OS X, 84-85

**application resources**

application-missing (Mac  
OS 8/9), 442-445, 454

attributes, purgeable and  
unpurgeable, 20-21, 25

creating, 19-21

data forks, 16-17

IDs, 18-19

Manager errors, 25-26

releasing, 25

resource forks, 16-17,  
1052-1053

signature, 430

template and definition  
resources, 21

types, 18-19

**Application Utilities,  
defined, 2****applications**

appearance-compliant,  
221-222

Classic event model and  
multiple monitors, 1407

database

event handlers, 895-899

*and callback functions,*  
895

*command events, 897*

*converting event refer-*  
*ence to event record,*

*898*

*cursor shape changing,*  
898-899

- event parameters*, 896-898
- handler disposal*, 899
- installing*, 895-896
- menu adjustment*, 898
- quit command*, 897-898
- window updating*, 899
- fragments, defined, 4
- IDs, 1056
- launching by Finder, 448
- menus, creating, 91-105
  - adding menus to menu list*, 105
  - hierarchical menus*, 104-105
  - 'MBAR' resource structure*, 91-92
  - 'MBAR' resources with Resorcerer*, 100
  - menu bar*, 104
  - 'MENU' resource structure*, 92-96
  - 'MENU' resources for submenus with Resorcerer*, 102
  - 'MENU' resources with Resorcerer*, 100-102
  - pull-down menus*, 104
  - 'xmenu' resource structure*, 96-99
  - 'xmenu' resources with Resorcerer*, 102-103
- partitions and memory, 5-6
- preferences, 1055-1056
- resources for Finder, 429-430
- sending sound commands, 1372
- server and client, 456
- Size menus (Mac OS X), 115-116
- target, 459

- theme-compliant, 221-222
- windows
  - creating*, 171-176
  - drawing window contents*, 176
  - positioning document windows*, 175-176
  - Resorcerer (resource editor) and*, 171
  - 'WIND' resources and*, 171-175
  - See also* Apple events
- Aqua "look", 225**
- arithmetic source modes, 539**
- arrow keys for cell selection, 1241-1242**
- arrowsActionFunction, 793**
- ascent line, 1137**
- ASCII character set, 1135**
- askSaveDiscardEvent Function, 1045**
- AsynchSoundLib**
  - functions*, 1378-1380
  - library*, 1377-1380
- ATSUI (Apple Type Services for Unicode Imaging), 1442**
- attribute constants, window, 857-858**
- attributes, Apple events, 457-460**
- auto-toggling**
  - checkboxes*, 257
  - radio buttons*, 258
- automatic drawing mode, 1250**
- automatic scrolling, 1150**

## B

### background

- colors*, 500, 536
- printing*, 797
- processes*, 44
- setting (MLTE)*, 1448

### balloon help for dialogs (Mac OS 8/9), 379-381

### bars and indicators (sliders), 682

### base line, 1137

### basic controls, 256-259

- checkboxes*, 257
- pop-up menu buttons*, 259
- push buttons*, 256-257
- radio buttons*, 257-258
- scroll bars*, 258-259
- visual feedback from*, 262-263

### bevel buttons

- alignment and placement constants*, 668-670
- behavior constants*, 665-666
- button and image well constants*, 667
- button content info structure*, 667, 674-675
- control data tag constants*, 667-672
- control part codes*, 672-673
- control values*, 665-667
- defined*, 663
- helper functions*, 672
- programmatic creation*, 673
- standard control*, 250
- states, active and disabled*, 673
- variants and control definition IDs*, 664-665

**BevellImagePictIcon.c,**  
780-783

**BevellImagePictIcon**  
**Content, 781-782**

**bit image, 502**

**bit patterns, 536-537**

**bitmapped glyphs, 1135**

**blocks**

logical and allocation,  
949-950

volume control (VCB), 953

**'BNDL' (bundle) resources,**  
**429, 437-440**

creating with Resorcerer,  
438

IDs, resource and local,  
439-440

**Boolean pattern modes,**  
**537-538**

**Boolean source modes,**  
**538**

**Bring All To Front, 158**

**brush type constants, 226**

**bundle ('BNDL') resources.**

See **'BNDL' (bundle)**  
**resources**

**bundles (Mac OS X), 453**

**button content info struc-**  
**ture, 667, 670-671,**  
**674-675**

## C

**C strings, 35-36**

**callback functions, 895**

See also **filter functions**

**callback procedure, 212**

**Callbacks.c, 792-793**

**calling in promises,**  
**1102-1103**

**Carbon Core services, 2**  
**Carbon Event Manager,**  
**892-945**

Apple events, 901

applications event han-  
dlers, 895-899

*callback functions, 895*

*command events, 897*

*converting event refer-*  
*ence to event record,*  
898

*cursor shape, 898-899*

*event parameters,*

896-898

*handler disposal, 899*

*installing, 895-896*

*menu adjustment, 898*

*quit command, 897-898*

*window updating, 899*

**CarbonEvents1 demonstra-**  
**tion program**

*code listing, 906-909*

*comments, 909-911*

**CarbonEvents2 demonstra-**  
**tion program**

*code listing, 911-938*

*comments, 938-945*

control hierarchies, 901

delay function alternative  
(Mac OS X), 901

events

*class and type, 893-894*

*event time, getting, 900*

*event timers, 893*

*filter functions, 901*

*propagation order, 893*

*reference, 893*

*sending, 899*

*timers, 900*

explicitly propagating  
events, 899

Main constants, 902-903

Main data types, 903-904

Main Event Manager and,  
42

Main functions and  
macros, 904-905

mouse tracking, 901

overview, 892-893

**RunApplicationEventLoop,**  
893

standard event handlers,  
892, 894

Window Manager and, 906

**Carbon printing, 796-846,**  
**800**

background, 797

Carbon printing Manager,  
796

CarbonPrinting demonstra-  
tion program

*code listing, 815-837*

*comments, 837-846*

documents

*Page Setup dialog, 805*

*Print dialog, 805-806,*  
811

*printing errors, 808*

*printing loop function,*  
806-807

*sequence and scope,*  
807-808

Finder (Mac OS 8/9) and,  
811

Main Carbon Printing  
Manager

*constants, 812-813*

*data types, 813*

*functions, 813-815*

Page Format objects, 811

page rectangles, 797-798

Page Setup

*customizing, 809-810*

*dialogs, 798-800*

paper rectangles, 797-798

PMDialog object, 810



- PMPageFormat objects, 800-803
- PMPrintSettings objects, 803-804
- Print dialog, 798-800
- Print dialogs, customizing, 809-810
- printer drivers, 797
- sessions in Carbon Print Manager, 796, 800
- settings, preserving user's, 800
- text, screen and printed, 808-809
- window -modal (sheet) dialogs, 809-810
- Carbon Printing Manager, 796**
- Carbon Scrap Manager**
  - CarbonScrap demonstration program
    - code listing*, 1105-1125
    - comments*, 1125-1131
  - constants and data types, 1099-1100
  - described, 1094
  - dialogs and scrap, 1103
  - main functions, 1099
  - private scrap, 1100-1103
    - additional actions*, 1101-1102
    - calling in promises*, 1102-1103
    - making promises*, 1102
    - old Scrap Manager*, 1100-1101
  - scrap, 1094-1100
    - clipboard windows*, 1098
    - cut and copy commands*, 1096
    - dialogs and*, 1103
    - edit menu commands*, 1095-1096
    - location of*, 1094
    - Main Carbon Scrap Manager functions*, 1099-1100
    - paste command*, 1096-1098
    - paste example*, 1097-1098
    - private scrap*, 1100-1103
    - scrap flavors*, 1095
    - scrap reference*, 1094-1095
    - transferring to disk (Mac OS 8/9)*, 1098-1099
  - TextEdit functions, 1103
- CarbonEvents1 demonstration program**
  - code listing*, 906-909
  - comments*, 909-911
  - doNewWindow*, 910
  - Main*, 910
  - windowEventHandler*, 910-911
- CarbonEvents2 demonstration program**
  - code listing*, 911-938
  - comments*, 938-945
  - appEventHandler*, 939-940
  - CarbonEvents2.c*, 939-943
  - dialogEventHandler*, 945
  - Dialogs.c*, 943-945
  - doCloseWindow*, 942
  - doControlHit1*, 943
  - doControlHit2*, 943
  - doDrawContent*, 943
  - doGetControls*, 943
  - doGetSheetHandler* UPP, 944
  - doIdle*, 943
  - doMovableModal Dialog*, 945
  - doNewWindow*, 942
  - doSheetAlert*, 943-944
  - doSheetDialog*, 944
  - Main*, 939
  - sheetEventHandler*, 944
  - windowEventHandler*, 940-942
- CarbonEvents2.c, 939-943**
- CarbonLib, 1413**
- CarbonPrinting demonstration program**
  - code listing*, 815-837
  - comments*, 837-846
  - CarbonPrinting.c*, 838-844
  - doCalcNumberOfPages*, 843
  - doCreateOrValidate PageFormat*, 840
  - doDrawPage*, 843-844
  - doDrawPrintInfo*, 844
  - doDrawRectStrings*, 844
  - doErrorAlert*, 844
  - doGetDocument*, 838-839
  - doMenuChoice*, 839-840
  - doPageSetUpDialog*, 840-841
  - doPrinting*, 842-843
  - doPrintSettingsDialog*, 841-842
  - doUpdateDocument Window*, 839
  - eventFilter*, 846
  - Global Variables*, 838

*initializationFunction*,  
844-845

*item evaluation function*, 845-846

*Main*, 838

*PrintDialogAppend.c*,  
844-846

*Printing.h*, 837-838

*typedefs*, 838

## **CarbonPrinting.c, 838-844**

## **CarbonScrap demonstration program**

code listing, 1105-1125

comments, 1125-1131

*appEventHandler*, 1126

*clipWindowEventHandler*, 1127

*Defines*, 1126

*doAdjustMenus*, 1127

*doClearCommand*,  
1129

*doClipboardCommand*,  
1130

*doCloseWindow*, 1127

*doCutCopyCommand*,  
1128

*doDrawClipboardWindow*, 1130-1131

*doDrawDocumentWindow*, 1131

*doInContent*, 1128

*doOpenDocumentWindows*, 1127

*doPasteCommand*,  
1129

*Global Variables*, 1126

*typedefs*, 1126

*windowEventHandler*,  
1127

## **caret position, 1138**

## **catalog entries, 961**

## **catalog file, 428, 448-450**

## **caution alert level, 341**

## **CDEF (control definition function), See under controls**

## **cell-selection algorithm**

customizing, 1241

default, 1240

## **cells, 1239**

data type, 1244

font, 1239

highlighting, 1239

selection

*algorithm, customizing*,  
1241

*arrow keys*, 1241-1242  
*with command key*,  
1240-1241

*default algorithm*, 1240

*keyboard, using*,  
1241-1243

*mouse, using*,  
1240-1241

*multiple*, 1240

*noncontiguous*, 1241

*shift-clicking*, 1241  
*with shift key*, 1240

*type*, 1242-1243

## **CFString objects, 37-39**

## **channels, sound**

allocation of, 1374

basics, 1371

## **character attributes, 1141-1142, 1152**

## **character encoding, 37**

## **character sets, 37**

## **character width, 546**

## **characters, sets, and codes, 1134-1135**

## **chasing arrows**

control data tag constants,  
705

control values, 705

idle processing, 711

programmatic creation,  
705

variants and control definition IDs, 704-705

## **Chasing arrows standard control, 251**

## **Checkbox standard control, 249**

## **checkboxes**

auto-toggling, 257

non-auto-toggling, 257

## **Choose a Folder dialog, 972-974**

## **ChooseAFolderDialog.c, 1048**

## **'cicn' (color icon), 614**

## **class, Apple events, 458**

## **class constants, window, 856**

## **Classic Event Manager, 42-77**

alerts and dialogs events,  
61-62

classic event model, 42-45

event information, obtaining,  
46-51

*event structure*, 46-49

*WaitNextEvent function*,  
50-51

events, handling, 52-61

*activate events*, 58-59

*keyboard events*, 55-56

*mouse events*, 52-55

*mouse-moved events*,  
60-61

*null events*, 59

*suspend and resume events*,  
59-60

*update events (Mac OS 8/9)*, 57-58

- flushing OS event queue, 52
- LowEvents demonstration program
  - code listing*, 67-72
  - comments*, 72-77
- Main Event Manager, 65-67
  - constants in*, 65-66
  - data types in*, 66
  - functions in*, 67
- 'SIZE' resource, 62-65
  - creating in CodeWarrior*, 62-65
  - ID*, 62
- Classic event model**
  - applications and multiple monitors, 1407
  - event categories, 43
  - events, low-level and OS, 44-45
  - events, priority of, 45
- click loop function, 1141**
- client applications, 456**
- clipboard windows, 1098**
- clipping region, 500, 607**
- clipWindowEventHandler, 1127**
- clock**
  - control data tag constants, 689
  - control part codes, 689
  - control values, 688
  - idle processing, 711
  - programmatic creation, 690
  - value flag constants, 689
  - variants and control definition IDs, 688
- Clock standard control, 252**
- close box, 157**
- closing**
  - files, 963
  - resource forks, 1052-1053
  - windows, 183-184
- CLUT (color lookup table), 497**
- 'CNTL' resources**
  - compiled structure, 268-270
  - creating with Resorcerer, 270-271
- code fragment resource, 5**
- code listings**
  - Appearance demonstration program, 231-242
  - AppleEvents demonstration program, 472-487
  - CarbonEvents1 demonstration program, 906-909
  - CarbonEvents2 demonstration program, 911-938
  - CarbonPrinting demonstration program, 815-837
  - CarbonScrap demonstration program, 1105-1125
  - Controls1 demonstration program, 294-313
  - Controls2 demonstration program, 323-333
  - Controls3 demonstration program, 728-777
  - DateTimeNumbers demonstration program, 1220-1232
  - DialogsAndAlerts demonstration program, 386-413
  - Drag demonstration program, 1318-1355
  - Files demonstration program, 987-1029
  - GworldPicCursIcn demonstration program, 627-650
  - Lists demonstration program, 1262-1290
  - LowEvents demonstration program, 67-72
  - Menus1 demonstration program, 120-131
  - Menus2 demonstration program, 136-149
  - Miscellany demonstration program, 1418-1434
  - MLTETextEditor demonstration program, 1461-1500
  - MonoTextEdit demonstration program, 1167-1204
  - MoreResources demonstration program, 1059-1082
  - PreQuickDraw demonstration program, 516-527
  - QuickDraw demonstration program, 559-589
  - SoundAndSpeech demonstration program, 1381-1391
  - SysMemRes demonstration program, 28-31
  - Windows1 demonstration program, 190-202
  - Windows2 demonstration program, 867-883
- codecs, 1370**
- CodeWarrior**
  - creating 'SIZE' resource in, 62-65
  - flags fields in, 62-65
- collapse box, 157**
- collection objects, 854-855**
- color icons ('cicn'), 614**
- color lookup table (CLUT). See CLUT**

**color models**

- CYMK model, 1402
- HLS and HSV models, 1403
- RGB model, 1402

**Color Picker, 1402-1405**

- CYMK model, 1402
- GetColor, invoking with, 1404-1405
- HLS and HSV models, 1403
- Miscellany demonstration program
  - code listing, 1418-1434*
  - comments, 1434-1439*
- RGB model, 1402
- using in HSV mode, 1404
- using in RGB mode, 1403-1404
- Utilities function, 1415

**Color Picker Utilities, 511****ColorPicker.c, 1438-1439****colors**

- and Appearance primitives, 223
- foreground and background, 536, 548
- on grayscale screens, 509
- RGB to pixel values, 506-509
- setting windows content region, 862

**command events, 897****command IDs**

- defined, 91
- used and not used, 113

**command key, 1240-1242****Command-key equivalents, 83-84****Command-period key-down events, 1401-1402****commands**

- cut and copy, 1096
- drawing, 606
- edit menu, 1095-1096
- paste, 1096-1098
- sound, 1371-1373

**comments on code listings**

- Appearance demonstration program, 242-246
- AppleEvents demonstration program, 487-494
- CarbonEvents1 demonstration program, 909-911
- CarbonEvents2 demonstration program, 938-945
- CarbonPrinting demonstration program, 837-846
- CarbonScrap demonstration program, 1125-1131
- Controls1 demonstration program, 314-323
- Controls2 demonstration program, 334-338
- Controls3 demonstration program, 778-794
- DateTimeNumbers demonstration program, 1232-1235
- DialogsAndAlerts demonstration program, 413-426
- Drag demonstration program, 1356-1366
- Files demonstration program, 1029-1048
- GworldPicCursIcn demonstration program, 650-659
- Lists demonstration program, 1290-1306
- LowEvents demonstration program, 72-77

Menus1 demonstration program, 131-136

Menus2 demonstration program, 149-153

Miscellany demonstration program, 1434-1439

MLTETextEditor demonstration program, 1500-1511

MonoTextEdit demonstration program, 1204-1220

MoreResources demonstration program, 1082-1091

PreQuickDraw demonstration program, 527-530

QuickDraw demonstration program, 589-599

SoundAndSpeech demonstration program, 1391-1395

SysMemRes demonstration program, 31-39

Windows1 demonstration program, 202-210

Windows2 demonstration program, 883-890

**components, sound, 1370****compression/decompression sound components, 1370****constants**

- alert default text, 347-348
- alert push button, 348
- animated cursors, 612
- Appearance Manager (cursors), 624
- append method, 361-362
- Carbon Event Manager, Main, 902-903
- Carbon Scrap Manager, 1099-1100
- controls (Main), 718-724

- ‘CURS’ and ‘crsr’
  - resources, 609-610
- cursors, 622
- dialog feature flag, 352-353
- dialog font flag, 364-365
- Finder and, 453
- Help tags, creating, 1409
- icons, 624-625
- Main Appearance Manager, 229-230
- Main Apple Event Manager, 470-471
- Main Carbon Printing Manager, 812-813
- Main Carbon Scrap Manager, 1104
- Main Control Manager, 288-290
- Main Dialog Manager, 382-383
- Main Drag Manager, 1315-1316
- Main Event Manager, 65-66
- Main File Manager, 980-981
- Main functions (dates, times, and numbers), 1165
- Main in Multilingual Text Engine, 1455-1457
- Main List Manager, 1259
- Main Menu Manager, 116-117
- Main Navigation Services, 983-984
- Main QuickDraw, 553
- Main Resource Manager, 27, 1057
- Main Window Manager, 187-188
- meta font, 365-366

- offscreen graphics worlds, 619
- pictures, 620
- QuickDraw preliminaries, 512
- relevant to sound, 1376
- scrolling in windows, 862
- setting the cursor, 611
- window attribute, 857-858
- window class, 856
- Window Manager, 906
- window positioning, 859-861
- windows, main, 864

### **content region, 499**

- mouse events in, 53
- windows, color and pattern in, 862

### **content type constants**

- bevel buttons, 667, 674-675
- button and image well, 667
- image wells, 674-675

### **Control Action function, 215**

### **control block, file, 951**

### **control data tag constants**

- bevel buttons, 667-672, 674-675
- chasing arrows, 705
- clock, 689
- disclosure triangles, 694
- edit text, 681
- group boxes, 687
- icons, 698
- image wells, 675
- pictures, 696
- progress and relevance bars, 691
- round button, 709
- scrolling text box, 707

- static text, 700-701
- tabs, 677
- universal procedure pointers and, 716-718
- user panes, 706, 716-717

### **control hierarchies, 901**

### **control IDs, 278**

### **Control Manager. See Main Control Manager**

### **control objects, 266-267**

### **control part codes**

- bevel buttons, 672-673
- clock, 689
- described, 663
- disclosure triangles, 695
- edit text, 681
- group boxes, 687
- icons, 698
- image wells, 675
- little arrows, 693
- pictures, 696
- radio groups, 704
- sliders, 684

### **control values, 370**

- bevel buttons, 665-667
- chasing arrows, 705
- clock, 688
- disclosure triangles, 694
- edit text, 680
- group boxes, 686
- icons, 697
- image wells, 674
- little arrows, 693
- pictures, 696
- placards, 699
- pop-up arrows, 702
- progress and relevance bars, 691
- radio groups, 704
- scrolling text box, 707
- separator lines, 701
- sliders, 684
- static text, 700



- tabs, 677
- user panes, 706
- window headers, 699

### **Control3.c, 779-780**

### **controls, 248-338, 662-794**

- accessor functions for control objects, 266-267
- activating and deactivating, 260-261
- basic controls, 256-259
- bevel buttons, 663-673
  - alignment and placement constants*, 668-670
  - behavior constants*, 665-666
  - button and image well constants*, 667
  - button content info structure*, 667, 674-675
  - control data tag constants*, 667-672
  - control part codes*, 672-673
  - control values*, 665-667
  - helper functions*, 672
  - programmatically creation*, 673
  - states, active and disabled*, 673
  - variants and control definition IDs*, 664-665
- chasing arrows, 704-705
  - control data tag constants*, 705
  - control values*, 705
  - idle processing*, 711
  - programmatically creation*, 705
  - variants and control definition IDs*, 704-705

- clock
  - clock value flag constants*, 689
  - control data tag constants*, 689
  - control part codes*, 689
  - control values*, 688
  - idle processing*, 711
  - programmatically creation*, 690
  - variants and control definition IDs*, 688
- control definition function (CDEF), 255-256
- control objects, 266-267
- control part code, 663
- control's kind, getting, 282-283
- Controls1 demonstration program
  - code listing*, 294-313
  - comments*, 314-323
- Controls2 demonstration program
  - code listing*, 323-333
  - comments*, 334-338
- Controls3 demonstration program
  - code listing*, 728-777
  - comments*, 778-794
- creating, 268-278
  - from 'CNTL' resources*, 268-271
  - control IDs*, 278
  - control titles font settings*, 275-278
  - pop-up menu buttons*, 274-275
  - programmatically*, 271-272
  - scroll bars*, 272-274
- data, setting, 265-266
- data tag constants, 662
- definition of, 254

- disclosure button, 708
- disclosure triangles
  - control data tag constants*, 694
  - control part codes*, 695
  - control values*, 694
  - helper functions*, 695
  - programmatically creation*, 695
  - variants and control definition IDs*, 694
- drawing order, 264
- edit text
  - control data tag constants*, 681
  - control part codes*, 681
  - control values*, 680
  - idle processing*, 711
  - programmatically creation*, 682
  - selection structure*, 682
  - small version*, 710
  - Unicode text*, 708
  - validation function, defining*, 713-714
  - variants and control definition IDs*, 680
- embedding controls, 263-265
- enabling and disabling, 262
- fundamentals, 248
- group boxes
  - control data tag constants*, 687
  - control part codes*, 687
  - control values*, 686
  - programmatically creation*, 687
  - variants and control definition IDs*, 685
- hiding and showing, 261-262

hit-testing, 264

icon

- control data tag constants*, 698
- control part codes*, 698
- control values*, 697
- programmatic creation*, 698
- variants and control definition IDs*, 696-697

idle processing, 711

image wells

- content type constants*, 674-675
- control data tag constants*, 675
- control part codes*, 675
- control values*, 674
- helper functions*, 675
- programmatic creation*, 675-676
- variants and control definition IDs*, 674

key filter function, defining, 711-713

latency, 265

little arrows

- control part codes*, 693
- control values*, 693
- programmatic creation*, 693
- variants and control definition IDs*, 692

Main constants, 718-724

Main Control Manager

- constants in*, 288-290
- data types in*, 291
- functions in*, 292-294

Main data types, 724-725

Main functions, 725-728

mouse events, handling, 279-282

- cursor tracking*, 281-282
- mouse-down events*, determining, 280-281

moving, 279

picture

- control data tag constants*, 696
- control part codes*, 696
- control values*, 696
- programmatic creation*, 696
- variants and control definition IDs*, 695

placards

- programmatic creation*, 700
  - variants and control definition IDs*, 699
- pop-up arrows, 701-703
- control values*, 702
  - programmatic creation*, 703
  - small version*, 710
  - variants and control definition IDs*, 702

primary group boxes, 260

progress and relevance

bars

- control data tag constants*, 691
- control values*, 691
- idle processing*, 711
- programmatic creation*, 692
- variants and control definition IDs*, 691

radio groups

- control part codes*, 704
- control values*, 704

*programmatic creation*, 704

*variants and control definition IDs*, 703

removing controls, 279

review of basics, 662-663

root control, 263

round button, 709-710

scroll bars, 283-287

*moving and resizing*, 283

*scrolling example*, 285-286

*scrolling operations basics*, 283-285

*scrolling TextEdit documents*, 287

scrolling text box, 706-708

*control data tag constants*, 707

*control values*, 707

*idle processing*, 711

*programmatic creation*, 708

*variants and control definition IDs*, 706-707

separator lines

- control values*, 701
- programmatic creation*, 701
- variants and control definition IDs*, 701

settings, changing, 282

sliders, 682-685

*control part codes*, 684

*control values*, 684

*programmatic creation*, 684-685

*small version*, 710

*variants and control definition IDs*, 683-684

- small versions of, 287, 709-710
- standard controls, listed, 248-254
- static text
  - control data tag constants*, 700-701
  - control values*, 700
  - programmatic creation*, 701
  - variants and control definition IDs*, 700
- tabs
  - control data tag constants*, 677
  - control values*, 677
  - helper functions*, 678
  - information resource*, 678-679
  - information structure*, 678
  - programmatic creation*, 676-679
  - small version*, 709
  - variants and control definition IDs*, 676-677
- updating controls, 279
- user pane functions, defining, 714-718
- user panes, 260, 705-706
  - control data tag constants*, 706, 716-717
  - control values*, 706
  - programmatic creation*, 706
  - variants and control definition IDs*, 705-706
- visual feedback from basic, 262-263

- window headers, 698-699
  - control values*, 699
  - programmatic creation*, 699
  - variants and control definition IDs*, 698-699
- windows, 167-168
- controls control lists, window, 167**

### Controls1 demonstration program

- code listing, 294-313
- comments, 314-323
  - actionFunctionHoriz*, 321
  - actionFunctionVert*, 320-321
  - Defines*, 315
  - doActivateWindow*, 318
  - doAdjustScrollbars*, 322-323
  - doCheckboxes*, 322
  - doGetControls*, 316-317
  - doInContent*, 318-319
  - doMenuChoice*, 317
  - doMouseDown*, 317
  - doMoveScrollBar*, 322
  - doOSEvent*, 318
  - doPopupMenuChoice*, 319
  - doPushButtons*, 322
  - doRadioButtons*, 322
  - doUpdate*, 317
  - doVertScrollbar*, 319-320
  - Global Variables*, 315
  - Main*, 315-316
  - typedef*, 315

### Controls2 demonstration program

- code listing, 323-333
- comments, 334-338
  - actionFunctionLive*, 337-338
  - actionFunctionNonLive*, 336-337
  - Defines*, 334
  - doActivateWindow*, 335
  - doInContent*, 335-336
  - doMoveScrollBar*, 338
  - doNonLiveScrollBars*, 336
  - doUpdate*, 335
  - Main*, 334-335

### Controls3 demonstration program

- code listing, 728-777
- comments, 778-794
  - arrowsActionFunction*, 793
  - BevellImagePictIcon.c*, 780-783
  - BevellImagePictIconContent*, 781-782
  - Callbacks.c*, 792-793
  - Control3.c*, 779-780
  - Control3.h*, 779
  - Defines*, 779
  - doActivateWindow*, 780
  - doBevellImagePictIcon.c*, 780
  - doChasingAndProgress*, 789-790
  - doCheckBoxGroupBox*, 789
  - doDrawLegends*, 783
  - doDrawMessage*, 783
  - doDrawPartCode*, 782
  - doDrawSliderValues*, 791



*doExtractCurrentStatus*,  
 790  
*doExtractDateTime*,  
 786  
*doExtractEditText*,  
 785-786  
*doGetControls*,  
 780-781  
*doGraphicAlignment*,  
 782  
*doGroupArrowsProgress*,  
 788-789  
*doMouseDown*, 779  
*doPopupGroupBox*, 789  
*doSliderUserPane*,  
 790-791  
*doSmallControls*, 794  
*doTabEditClock*,  
 784-785  
*doTextAlignment*, 783  
*doTextOffset*, 783  
*doTextPlacement*, 783  
*doUpdate*, 780  
*editTextValidator*,  
 786-787  
*eventFilter*, 792-793  
*GroupArrowsProgress.c*,  
 787-790  
*numericFilter*, 786  
*sliderActionFunction1*,  
 793  
*sliderActionFunction2*,  
 793  
*Sliders.c*, 790-792  
*SmallControls.c*, 794  
*TabEditClock.c*,  
 783-787  
*TextBox.c*, 792  
*typedefs*, 779  
*userPaneActivate*  
*Function*, 792  
*userPaneDrawFunction*,  
 791

**cooperative multitasking**  
**(Mac OS 8/9), 51**  
**coordinate plane, 532-535**  
**coordinate system**  
 global, 532-533  
 local, 532  
**Copy to Window, 653**  
**Core Foundation**  
**(CFString objects), 37-39**  
**Core Foundation**  
**Preferences Services,**  
**1055-1056**  
 application ID, 1056  
 domains, 1056  
 setting, storing, and  
 retrieving, 1056  
**Core Foundation services,**  
**3**  
**core suite, 457**  
**CreateNewWindow func-**  
**tion, 855**  
**CreateStandardAlert**  
**function, 349**  
**creation/disposal func-**  
**tions, 217**  
**cross-mode calls, 214**  
**'crsr' resources**  
 custom, 610  
 system, 609-610  
**current device, 1406**  
**current list, changing,**  
**1252-1253**  
**current pen state, 535**  
**current printer, 797**  
**current resource file,**  
**1051-1052**  
**'CURS' resources**  
 custom, 610  
 system, 609-610

**cursors, 608-613**  
 animated (Mac OS 8/9),  
 612-613  
 Appearance Manager con-  
 stants, data types, and  
 functions, 624  
 Appearance Manager, set-  
 ting functions in, 228  
 defined, 608  
 drawing, 551  
 GworldPicCursIcn demon-  
 stration program  
*code listing*, 627-650  
*comments*, 650-659  
 hot spot, 608  
 Main constants, data types,  
 and functions, 622-623  
 movement, 608  
 non-animated, 609-612  
 shape, 609  
 shape changing, 898-899  
 tracking in a control,  
 281-282  
 visibility, 609  
**custom controls, 248**  
**custom list definition**  
**functions, 1248-1249,**  
**1257-1258**  
**custom match functions,**  
**1252**  
**customClickLoop,**  
**1209-1210**  
**cut and copy commands,**  
**1096**  
**CYMK color model, 1402**

## D

**data**  
 in Apple events, 466-467  
 associating with windows,  
 861

- buffer, 951
- cache structure, 1155-1158
- managing in cells, 1251-1252
- reading file, 957-958
- reading into file, 955
- setting in controls, 265-266
- setting in MLTE, 1454-1455
- sound, 1369

### **Data Browser standard control, 253**

### **data fork, 948-949**

### **data tag constants, control, 265-266, 662**

### **data types**

- Appearance Manager, 558
- Appearance Manager (cursors), 624
- Carbon Scrap Manager, 1099-1100
- controls (main), 724-725
- creating Help tags, 1408
- cursors, 622-623
- Finder and, 453-454
- icons, 626
- Main Appearance Manager, 230
- Main Apple Event Manager, 471-472
- Main Carbon Event Manager, 903-904
- Main Carbon Printing Manager, 813
- Main Carbon Scrap Manager, 1104
- Main Control Manager, 291
- Main Dialog Manager, 383-384
- Main Drag Manager, 1316
- Main Event Manager, 66
- Main File Manager, 981

- Main functions (dates, times, and numbers), 1165-1166
- main in Multilingual Text Engine, 1457-1458
- Main List Manager, 1259-1260
- Main Memory Manager, 26
- Main Menu Manager, 117
- Main Navigation Services, 984-985
- Main Notification Manager, 1414
- Main QuickDraw, 554
- Main Resource Manager, 27, 1057
- Main Window Manager, 188
- offscreen graphics worlds, 619
- pictures, 620-621
- QuickDraw preliminaries, 512-514
- relevant to sound, 1376-1377
- Text Utilities, 1262
- windows, main, 865

### **dates and times,**

#### **1154-1158**

- date-time values and structures, 1155-1158
- DateTimeNumbers demonstration program
  - code listing, 1220-1232*
  - comments, 1232-1235*
- international resources, 1154
- Main constants, data types, and functions, 1165-1167
- Text Utilities, 1154

### **DateTimeNumbers**

#### **demonstration program**

- code listing, 1220-1232
- comments, 1232-1235
  - doAcceptNewRecord, 1233-1234*
  - doDate, 1235*
  - doIdle, 1233*
  - doTodaysDate, 1233*
  - doUnitAndTotalValue, 1234*
  - Global Variables, 1232*
  - main, 1232-1233*
  - windowEventHandler, 1233*

### **Define Picture Rectangle, 654-655**

### **Defines**

- CarbonScrap demonstration program, 1126
- Controls1 demonstration program, 315
- Controls2 demonstration program, 334
- Controls3 demonstration program, 779
- DialogsAndAlerts demonstration program, 415
- Drag demonstration program, 1356
- GworldPicCursIcn demonstration program, 650-651
- Lists demonstration program, 1291
- LowEvents demonstration program, 73
- Menus1 demonstration program, 131
- MonoTextEdit demonstration program, 1205, 1214
- MoreResources demonstration program, 1083

- QuickDraw demonstration program, 589
- SoundAndSpeech demonstration program, 1391
- Windows1 demonstration program, 203
- Windows2 demonstration program, 884
- definition IDs and functions (windows), 162-163**
- definition resources, 21**
- demonstration programs**
  - code listings
    - Appearance*, 231-242
    - AppleEvents*, 472-487
    - CarbonEvents1*, 906-909
    - CarbonEvents2*, 911-938
    - CarbonScrap*, 1105-1125
    - Controls2*, 323-333
    - Controls3*, 728-777, 815-837
    - DialogsAndAlerts*, 386-413
    - Drag*, 1318-1355
    - Files*, 987-1029
    - GworldPicCursIcn*, 627-650
    - Lists*, 1262-1290
    - LowEvents*, 67-72
    - Menus1*, 120-131
    - Menus2*, 136-149
    - Miscellany*, 1418-1434
    - MLTETextEditor*, 1461-1500
    - MonoTextEdit*, 1167-1204, 1220-1232
    - MoreResources*, 1059-1082
    - PreQuickDraw demonstration program*, 527-530
    - QuickDraw*, 589-599
    - SoundAndSpeech*, 1391-1395
    - SysMemRes*, 31-39
    - Windows2*, 883-890
  - creation/disposal functions and, 217
- descent line, 1137**
- descriptor lists, 462-463**
- descriptor type, 460**
- desktop database (Mac OS 8/9), 428, 439-440**
- desktop region, 167**
- destination rectangle, 1142**
- detaching resources, 1052**
- determinate progress bar, 690**
- device list, 1405**
- DeviceLoop function, 1406-1407**
- deviceLoopDraw**
  - in *Miscellany* demonstration program, 1439
- 'dftb' resources**
  - compiled structure, 363-366
  - Resorcerer, creating with, 366
- dialog font flag constants, 364-365**
- Dialog Manager primitives, 355-356**
- dialog objects, 350**
- dialogEventHandler, 945**
- DialogList.c, 1305-1306**
- comments on code listings*
  - Appearance*, 242-246
  - AppleEvents*, 487-494
  - CarbonEvents1*, 909-911
  - CarbonEvents2*, 938-945
  - CarbonScrap*, 1125-1131
  - Controls2*, 334-338
  - Controls3*, 778-794, 837-846
  - DateTimeNumbers*, 1232-1235
  - DialogsAndAlerts*, 413-426
  - Drag*, 1356-1366
  - Files*, 1029-1048
  - GworldPicCursIcn*, 650-659
  - Lists*, 1290-1306
  - LowEvents*, 72-77
  - Menus1*, 131-136
  - Menus2*, 149-153
  - Miscellany*, 1434-1439
  - MLTETextEditor*, 1500-1511
  - MonoTextEdit*, 1204-1220
  - MoreResources*, 1082-1091

## dialogs and alerts, 340-426

alert types, modalities, and levels, 340-342

alerts, creating and removing, 345-349

*CreateStandardAlert*

*function*, 349

*removing*, 349

*StandardAlert function*,

346-348

balloon help for dialogs

(Mac OS 8/9), 379-381

Choose a Folder dialog,  
972-974

closing and disposing of  
dialogs, 377-378

content of, 345

dialog types and modalities,  
342-343

dialogs and scrap, 1103

dialogs, creating, 350-355

*dialog objects*, 350

*'DLOG' and 'dlgx'*

*resources*, 351-354

*NewFeaturesDialog*

*function*, 354-355

dialogs windows, 160, 164

DialogsAndAlerts demonstration program

*code listing*, 386-413

*comments*, 413-426

displaying

*menu adjustment*,

367-369

*multiple alerts and*

*dialogs*, 369

*resizing*, 369

*window deactivation*,

367-368

events handling in,

370-376

*controls events*,

370-371

*event filter functions*,

374-376

*modal alerts events*,

371-372

*modal dialogs events*,

372-374

*modeless dialogs*

*events*, 377

*overview*, 370

help tags for dialogs (Mac OS X), 382

introduction to, 340

items in dialogs, 355-366

*default push buttons*,

358-359

*'dfib' resources*,

363-366

*Dialog Manager primitives*,

355-356

*'DITL' resource*,

356-358

*edit text and static text*,

362

*enabling and disabling*,

360

*keyboard focus*, 360

*layout guidelines for*,

358

*manipulating items*,

360-362

*simulating item selec-*

*tion*, 374

levels of alert, 340-342

Main Dialog Manager

*constants in*, 382-383

*data types in*, 383-384

*functions in*, 384-386

modal alerts, 340

modal dialogs, 342-343

modeless dialogs, 343

movable modal dialogs,  
343

Navigation Services

*listed*, 964

*modality*, 965

*primary dialogs inter-*  
*face elements*,

965-966

push buttons, default, 345

Save Location dialog, 972

Window Manager func-

*tions* (Mac OS X), 386

window-modal alerts,

378-379

window-modal dialogs,

379

window-modal dialogs

(Mac OS X), 343

window types for, 343-344

## DialogsAndAlerts demon- stration program

*code listing*, 386-413

*comments*, 413-426

*Defines*, 415

*DialogsAndAlerts.c*,

416-426

*DialogsAndAlerts.h*,

415

*doActivate*, 419

*doActivateDialogs*, 419

*doActivateDocument*,

419

*doAdjustMenus*, 420

*doButtonHitInSearch*

*Modeless*, 425

*doButtonHitInSheet*

*Dialog*, 426

*doCopyString*, 426

*doCreateOrShow*

*ModelessDialog*, 424

- doDemonstrationMenu*, 420
- doDrawMessage*, 426
- doEditMenu*, 420
- doEvents*, 417
- doExplicitlyDeactivateDocument*, 420
- doHideModelessDialog*, 425
- doIdle*, 416-417
- doInContent*, 424
- doKeyDown*, 417-418
- doMenuChoice*, 420
- doModalAlerts*, 420-421
- doModalDialog*, 422-423
- doMouseDown*, 417
- doMovableModalAlertOnX*, 421-422
- doMovableModalDialog*, 423-424
- doPlaySound*, 426
- doPopUpMenuChoice*, 426
- doSheetAlert*, 426
- doSheetDialog*, 426
- doUpdate*, 418-419
- doUpdateDocument*, 419
- eventFilter*, 425
- eventLoop*, 416
- Global Variables*, 416
- Global Variables (Sheets.c)*, 426
- Main*, 416
- Sheets.c*, 426
- DialogsAndAlerts.c**, 416-426
- DialogsAndAlerts.h**, 415
- Dialogs.c**, 943-945
- direct colors and devices**, 497-498
- direct devices, pixel values**, 507-508
- Discard Changes alert**, 975
- disclosure button**, 708
- Disclosure button standard control**, 253
- Disclosure triangle standard control**, 250
- disclosure triangles**, 693-695
  - control data tag constants, 694
  - control part codes, 695
  - control values, 694
  - helper functions, 695
  - programmatic creation, 695
  - variants and control definition IDs, 694
- disk cache**, 952
- dispatch structure**, 1142, 1145
- Display Information from Pictinfo**, 655
- dithering**, 548
- 'DITL' resource**, 356-358
- 'DLOG' and 'dlgx' resources**
  - 'dlgx' compiled structure, 352-353
  - 'DLOG' compiled structure, 351-352
  - Resorcerer, creating with, 353-354
- doAboutDialog**, 659
- doAcceptNewRecord**, 1233-1234
- doActivate**
  - DialogsAndAlerts demonstration program, 419
  - MLTETextEditor demonstration program, 1502-1503
  - Windows1 demonstration program, 207
- doActivateDeactivate**
  - Lists demonstration program, 1294
  - MonoTextEdit demonstration program, 1208-1209
- doActivateDialogs**, 419
- doActivateDocument**, 419
- doActivateDocumentWindow**, 886
- doActivateWindow**
  - Appearance demonstration program, 244
  - Controls1 demonstration program, 318
  - Controls2 demonstration program, 335
  - Controls3 demonstration program, 780
  - Windows1 demonstration program, 207-208
- doAddRowsAndData TolconList**, 1297-1298
- doAddRowsAndDataTo TextList**, 1296
- doAddTextItemAlphabetically**, 1296-1297
- doAdjustCursor**
  - Drag demonstration program, 1358
  - LowEvents demonstration program, 76-77
  - MonoTextEdit demonstration program, 1213



**doAdjustFileMenu, 1504****doAdjustMenus**

- CarbonScrap demonstration program, 1127
- DialogsAndAlerts demonstration program, 420
- Drag demonstration program, 1358
- Files demonstration program, 1032
- Menus1 demonstration program, 134
- MonoTextEdit demonstration program, 1211
- Windows2 demonstration program, 886

**doAdjustScrollbars**

- Controls1 demonstration program, 322-323
- MonoTextEdit demonstration program, 1212-1213

**doAnimatedCursor1, 656-657****doAnimatedCursor2, 657****doAnimatedCursorOSX, 659****doAppleApplication Menu, 135****doArithmeticSourceModes, 596****doArrowKeyExtend Selection, 1299****doArrowKeyMoveSelection, 1298-1299****doBevellImagePictIcon.c, 780****doBooleanSourceModes, 595-596****doButtonHitInSearch Modeless, 425****doButtonHitInSheetDialog, 426****doCalcNumberOfPages, 843****doChangeCursor, 656****doChangeKeyBoardFocus, 246****doChasingAndProgress, 789-790****doCheckboxes, 322****doCheckBoxGroupBox, 789****doCheckMonitor, 529-530****doCheckStyleMenuItem, 153****doChooseAFolderDialog, 1048****doClearCommand, 1129****doClipboardCommand, 1130****doCloseCommand**

- Files demonstration program, 1036
- MLTETextEditor demonstration program, 1508-1509

**doCloseDocWindow, 1038****doCloseHelp, 1220****doCloseWindow**

- CarbonEvents2 demonstration program, 942
- CarbonScrap demonstration program, 1127
- Drag demonstration program, 1358
- MLTETextEditor demonstration program, 1511
- MonoTextEdit demonstration program, 1213
- MoreResources demonstration program, 1085
- Windows1 demonstration program, 209-210
- Windows2 demonstration program, 890

**doColorMenuChoice, 1507****doCommand, 153****doConcatPStrings, 210****doControlHit, 1295****doControlHit1, 943****doControlHit2, 943****doCopyAResource, 1046****doCopyResource, 1087-1088****doCopyResources, 1045-1046****doCopyString, 426****doCreateAskSaveChanges Dialog, 1039****doCreateFloatingWindows, 887****doCreateIconList, 1297****doCreateNewWindow, 887-888****doCreateOrShowModeless Dialog, 424****doCreateOrValidatePage Format, 840****doCreateTextList, 1295-1296****doCreateWindowFrom Resource, 889-890****document windows**

- creating, 955, 957
- defined, 156
- positioning, 175-176
- types, 158-159

**documents**

- printing, 805-808
  - errors, 808*
  - Page Setup dialog, 805, 811*
  - Print dialog, 805-806*
  - printing loop function, 806-807*
- structures, 176, 954-955

**doCursor, 655**

**doCutCopyCommand, 1128**

**doDate, 1235**

**doDecimalToHexadecimal, 1439**

**doDemonstrationMenu**

DialogsAndAlerts demonstration program, 420

QuickDraw demonstration program, 590

**doDisplayInformation, 528**

**doDisplayMessageToUser, 1437-1438**

**doDrawAppearance Primitives, 244**

**doDrawCaret, 1362**

**doDrawClipboardWindow, 1130-1131**

**doDrawColorPickerChoice, 1438-1439**

**doDrawContent**

CarbonEvents2 demonstration program, 943

Files demonstration program, 1032

Lists demonstration program, 1294

MonoTextEdit demonstration program, 1208

MoreResources demonstration program, 1084

**doDrawDataPanel, 1214**

**doDrawDocumentWindow, 1131**

**doDrawFrameAndFocus, 1303-1304**

**doDrawingState, 599**

**doDrawingStateProof, 599**

**doDrawLegends, 783**

**doDrawListViewOn9, 245**

**doDrawMessage**

Controls3 demonstration program, 783

DialogsAndAlerts demonstration program, 426

**doDrawPage, 843-844**

**doDrawPartCode, 782**

**doDrawPictures, 1219**

**doDrawPrintInfo, 844**

**doDrawRectStrings, 844**

**doDrawSelections, 1304**

**doDrawSliderValues, 791**

**doDrawThemeCompliant TextOn9, 244-245**

**doDrawThemeTextOnX, 245-246**

**doDrawWithMouse, 597-598**

**doEditMenu**

DialogsAndAlerts demonstration program, 420

Drag demonstration program, 1358

Menus1 demonstration program, 135

MLTETextEditor demonstration program, 1504-1505

MonoTextEdit demonstration program, 1211-1212

**doEditMenuChoice, 1507**

**doEnableDisableMenus, 1504**

**doErrorAlert**

CarbonPrinting demonstration program, 844

MLTETextEditor demonstration program, 1504

Windows1 demonstration program, 210

Windows2 demonstration program, 890

**doEvents**

Appearance demonstration program, 243

AppleEvents demonstration program, 490

DialogsAndAlerts demonstration program, 417

GworldPicCursIcn demonstration program, 651-652

LowEvents demonstration program, 74-75

Menus1 demonstration program, 133-134

MLTETextEditor demonstration program, 1502

PreQuickDraw demonstration program, 528

QuickDraw demonstration program, 589

Windows1 demonstration program, 204

**doExplicitlyDeactivateDocument, 420**

**doExtractCurrentStatus, 790**

**doExtractDateTime, 786**

**doExtractEditText, 785-786**

**doExtractSelections, 1304**

**doFileMenu**

Menus1 demonstration program, 135

MonoTextEdit demonstration program, 1211

Windows1 demonstration program, 208

**doFileMenuChoice, 1506-1507**

**doFillEraseInvert, 592**

- doFindFirstSelectedCell,** 1301
- doFindLastSelectedCell,** 1301
- doFindNewCellLoc,** 1302
- doFontMenu,** 135-136
- doFontMenuChoice,** 1507
- doFrameAndPaint,** 591
- doGetAnimCursor,** 657-658
- doGetCharAtOffset,** 1365
- doGetControls**
  - CarbonEvents2 demonstration program, 943
  - Controls1 demonstration program, 316-317
  - Controls3 demonstration program, 780-781
- doGetDepthAndDevice,** 246
- doGetDocument,** 838-839
- doGetLine,** 1362
- doGetMenus**
  - Menus1 demonstration program, 132-133
  - Menus2 demonstration program, 150-152
- doGetOffset,** 1361-1362
- doGetPageFormat,** 1090
- doGetPictureInfo,** 1216-1217
- doGetPreferencesCFPrefs,** 1087
- doGetPreferencesResource,** 1086-1087
- doGetSelectLength,** 1212
- doGetSheetHandlerUPP,** 944
- doGetSleepTime,** 1501-1502
- doGetText,** 1216
- doGraphicAlignment,** 782
- doGroupArrowsProgress,** 788-789
- doHandleArrowKey,** 1298
- doHasGotRequiredParams,** 493
- doHelp,** 1214-1215
- doHelpTagControl,** 1439
- doHideModelessDialog,** 425
- doHighlighting,** 597
- dolcon,** 659
- doldle**
  - CarbonEvents2 demonstration program, 943
  - DateTimeNumbers demonstration program, 1233
  - DialogsAndAlerts demonstration program, 416-417
  - Files demonstration program, 1032
  - GworldPicCursIcn demonstration program, 651
  - Miscellany demonstration program, 1437
  - MLTETextEditor demonstration program, 1502
  - MonoTextEdit demonstration program, 1206
  - SoundAndSpeech demonstration program, 1392
- dolnContent**
  - CarbonScrap demonstration program, 1128
  - Controls1 demonstration program, 318-319
  - Controls2 demonstration program, 335-336
  - DialogsAndAlerts demonstration program, 424
  - Drag demonstration program, 1357
  - Lists demonstration program, 1295
  - MonoTextEdit demonstration program, 1208
- dolncrementAnimCursor,** 658
- dolnitialiseSoundLib,** 1392
- dolnitializeMLTE,** 1501
- dolninsertTextAtOffset,** 1365
- dolninstallAEHandlers**
  - AppleEvents demonstration program, 490
  - Files demonstration program, 1032
  - MLTETextEditor demonstration program, 1501
- dolninstallAnAEHandler,** 490
- dolnvalidateScrollBarArea,** 210
- doJustificationMenuChoice,** 1508
- doKeyDown**
  - DialogsAndAlerts demonstration program, 417-418
  - Lists demonstration program, 1293-1294
- doKeyEvent**
  - Drag demonstration program, 1357
  - MonoTextEdit demonstration program, 1206-1207
- doLDEFDraw,** 1305
- doLDEFHighlight,** 1305
- doLines,** 590
- doListsDialog,** 1305-1306
- doLoadAndSetWindowSizeAndPosition,** 1089
- domains, preference,** 1056



**doMakeCellVisible,  
1302-1303****doMemory, 33-34****doMenuChoice**

- CarbonPrinting demonstration program, 839-840
- Controls1 demonstration program, 317
- DialogsAndAlerts demonstration program, 420
- Files demonstration program, 1032
- GworldPicCursIcn demonstration program, 652
- Menus1 demonstration program, 134-135
- Menus2 demonstration program, 152
- Miscellany demonstration program, 1436
- MonoTextEdit demonstration program, 1211
- Windows1 demonstration program, 208
- Windows2 demonstration program, 886-887

**doModalAlerts, 420-421****doModalDialog, 422-423****doMouseDown**

- Controls1 demonstration program, 317
- Controls3 demonstration program, 779
- DialogsAndAlerts demonstration program, 417
- LowEvents demonstration program, 75
- Menus1 demonstration program, 134
- Windows1 demonstration program, 204-206
- Windows2 demonstration program, 885

**doMouseown, 1502****doMovableModalAlertOn  
X, 421-422****doMovableModalDialog**

- CarbonEvents2 demonstration program, 945
- DialogsAndAlerts demonstration program, 423-424

**doMoveScrollBar**

- Controls1 demonstration program, 322
- Controls2 demonstration program, 338

**doNewCommand**

- Files demonstration program, 1035
- MLTETextEditor demonstration program, 1508

**doNewDocWindow**

- Drag demonstration program, 1357-1358
- Files demonstration program, 1037-1038
- MLTETextEditor demonstration program, 1510-1511
- MonoTextEdit demonstration program, 1209

**doNewWindow**

- AppleEvents demonstration program, 494
- CarbonEvents1 demonstration program, 910
- CarbonEvents2 demonstration program, 942
- LowEvents demonstration program, 73
- SysMemRes demonstration program, 33
- Windows1 demonstration program, 208-209

**doNonLiveScrollBars, 336****doOffScreenGWorld1, 652****doOffScreenGWorld2,  
653-654****doOpenAppEvent, 490****doOpenCommand**

- Files demonstration program, 1035
- MLTETextEditor demonstration program, 1508
- MonoTextEdit demonstration program, 1213-1214
- MoreResources demonstration program, 1084

**doOpenDocsEvent,  
491-492****doOpenDocumentWindows, 1127****doOpenFile**

- AppleEvents demonstration program, 493
- Files demonstration program, 1038-1039
- MLTETextEditor demonstration program, 1511
- MonoTextEdit demonstration program, 1213-1214

**doOpenListsWindow,  
1293****doOpenWindow, 1085****doOSEvent**

- Controls1 demonstration program, 318
- LowEvents demonstration program, 76
- Windows1 demonstration program, 208

**doPageSetUpDialog,  
840-841****doPageSetupDialog, 1086****doPasteCommand, 1129****doPicture, 654**

- doPlayResourceASync**, 1394-1395
- doPlayResourceSync**, 1392-1393
- doPlaySound**, 426
- doPolygonAndRegion**, 593
- doPopupGroupBox**, 789
- doPopupMenuChoice**
  - Controls1 demonstration program, 319
  - DialogsAndAlerts demonstration program, 426
- doPreferencesDialog**, 1086
- doPreliminaries**
  - LowEvents demonstration program, 73
  - Menus1 demonstration program, 132
  - SysMemRes demonstration program, 33
  - Windows1 demonstration program, 204
- doPrepareColorMenu**, 1506
- doPrepareFontMenu**, 1505
- doPrepareJustification Menu**, 1506
- doPrepareNotification Structure**, 1436-1437
- doPrepareSizeMenu**, 1505
- doPrepareStyleMenu**, 1506
- doPrepareToTerminate**, 494
- doPrintDocsEvent**, 492
- doPrintFile**, 493-494
- doPrinting**, 842-843
- doPrintSettingsDaialog**, 841-842
- doPushButtons**, 322
- doQuitAppEvent**, 492
- doQuitCommand**, 1510
- doRadioButtons**, 322
- doRandomNumber**, 599
- doReadPictFile**, 1042
- doReadTextFile**, 1042
- doRecordResource**, 1393-1394
- doReleaseAnimCursor**, 658
- doReopenAppEvent**, 491
- doResetTypeSelection**, 1303
- doResources**, 34-35
- doRestoreBackground**, 1292
- doRestoreMonitorPixel Depth**, 530
- doRevertCommand**
  - Files demonstration program, 1037
  - MLTETextEditor demonstration program, 1509
- doRotateCurrentList**, 1303
- doSaveAsCommand**
  - Files demonstration program, 1036-1037
  - MLTETextEditor demonstration program, 1509
- doSaveAsFile**, 1213-1214
- doSaveBackground**, 1292
- doSaveCommand**
  - Files demonstration program, 1036
  - MLTETextEditor demonstration program, 1509
- doSavePageFormat**, 1090-1091
- doSavePreferencesCFPrefs**, 1088-1089
- doSavePreferences Resource**, 1088
- doSavePreinsertionText**, 1365-1366
- doSaveUsingFSRef**, 1040-1041
- doSaveUsingFSSpec**, 1039-1040
- doSaveWindow**, 888-889
- doSaveWindowSizeAnd Position**, 1089-1090
- doScrolling**, 594-595
- doScrollTextAndPicts**, 1219
- doSearchPartialMatch**, 1300-1301
- doSelectOneCell**, 1302
- doSetBackgroundWhite**
  - Lists demonstration program, 1292
  - MonoTextEdit demonstration program, 1220
- doSetMonitorPixelDepth**, 530
- doSetScrollBarValue**, 1210
- doSetUpDialog**, 1395
- doSetUpNotification**, 1436
- doSheetAlert**
  - CarbonEvents2 demonstration program, 943-944
  - DialogsAndAlerts demonstration program, 426
- doSheetDialog**
  - CarbonEvents2 demonstration program, 944
  - DialogsAndAlerts demonstration program, 426
- doSizeMenu**, 136
- doSizeMenuChoice**, 1507
- doSliderUserPane**, 790-791
- doSmallControls**, 794
- doSmallSysFontChangeEvent**, 492

**doSpeakStringAsync,**  
1395

**doSpeakStringSync,** 1394

**doSpecialMenu,** 136

**doStartDrag,** 1358-1359

**doStyleMenuChoice,** 1507

**doSubMenus,** 136

**doSynchroniseFiles,**  
1046-1047

**doSynchronizeFiles,** 1503

**doSysFontChangeEvent,**  
492

**doTabEditClock,** 784-785

**doText,** 594

**doTextAlignment,** 783

**doTextOffset,** 783

**doTextPlacement,** 783

**doTodaysDate,** 1233

**doTouchWindow,** 1033

**doTypeSelectSearch,**  
1299-1300

**doUndoRedoDrag,** 1366

**doUnitAndTotalValue,**  
1234

**doUpdate**

Appearance demonstration  
program, 244

Controls1 demonstration  
program, 317

Controls2 demonstration  
program, 335

Controls3 demonstration  
program, 780

DialogsAndAlerts demon-  
stration program,  
418-419

LowEvents demonstration  
program, 76

MLTETextEditor demon-  
stration program, 1503

Windows1 demonstration  
program, 206

Windows2 demonstration  
program, 886

**doUpdateDocument,** 419

**doUpdateDocument**  
**Window**

CarbonPrinting demonstra-  
tion program, 839

Windows2 demonstration  
program, 886

**doUpdateWindow,** 207

**doVertScrollbar,** 319-320

**doViewsFontChangeEvent,**  
492

**doWindowsMenu,** 208

**doWriteFile**

Files demonstration pro-  
gram, 1041-1042

MLTETextEditor demon-  
stration program, 1511

**doWritePictData,** 1043

**doWriteTextData,**  
1042-1043

**drag and drop,** 1308-1366

Drag demonstration pro-  
gram

*code listing,* 1318-1355  
*comments,* 1356-1366

drag handlers, 1309,  
1311-1313

drag image, 1313-1314

drag input function, 1315

drag item flavors,  
1309-1311

drag items, 1309-1310

Drag Manager, 1308

Drag Manager default,  
overriding, 1314-1315

drag reference, 1309

drag region, 1313

drawing function, 1315

finishing drags, 1309

Main Drag Manager,  
1315-1318

overview, 1308-1309

send data function, 1315

starting drags, 1308-1309

tracking drags, 1309

**Drag demonstration**  
**program**

*code listing,* 1318-1355

*comments,* 1356-1366

*Defines,* 1356

*doAdjustCursor,* 1358

*doAdjustMenus,* 1358

*doCloseWindow,* 1358

*doDrawCaret,* 1362

*doEditMenu,* 1358

*doGetCharAtOffset,*  
1365

*doGetLine,* 1362

*doGetOffset,* 1361-1362

*doInContent,* 1357

*doInsertTextAtOffset,*  
1365

*doKeyEvent,* 1357

*doNewDocWindow,*  
1357-1358

*doSavePreinsertionText,*  
1365-1366

*doStartDrag,*  
1358-1359

*doUndoRedoDrag,*  
1366

*Drag.c,* 1357-1358

*Drag.h,* 1356

*dragReceiveHandler,*  
1362-1365

*dragTrackingHandler,*  
1359-1360

*Enter Handler,* 1360

*Enter Window,* 1360

*Global Variables,* 1357

*isOffsetAtLineStart,*  
1362

*isWhiteSpace,* 1365

*isWhiteSpaceAt Offset,*  
1365

*Leave Window*, 1361  
*Main*, 1357  
*ReceiveAndUndoDrag.c*,  
 1362-1366  
*StartAndTrack.c*,  
 1358-1362  
*typedefs*, 1356  
*In Window*, 1360-1361  
*windowEventHandler*,  
 1357

**drag receive handlers**,  
 1309, 1311-1312

**Drag.c**, 1357-1358

**draggable area**, 157

**dragging in windows**,  
 180-181

**dragging windows**, 1407

**Drag.h**, 1356

**dragReceiveHandler**,  
 1362-1365

**dragTrackingHandler**,  
 1359-1360

**Draw in Offscreen  
 Graphics Port**, 653

**Draw in Window**, 652

**draw message**, 1258

**Draw Picture**, 655

**draw state constants**,  
 224-225

**drawEventString**, 76

**drawing**

automatic mode in lists,  
 1250  
 in colors and patterns,  
 225-227  
 focus rectangle, 1249  
 icons, 616-618  
 list box frame, 1249  
 offscreen graphics worlds,  
 603-604  
 pictures, 607

**drawing functions**

in Appearance primitives,  
 223-224  
 Drag Manager and, 1315

**drawing order (controls)**,  
 264

**drawing with QuickDraw**,  
 532-599

Appearance Manager  
*data types*, 558  
*functions*, 558  
 bit patterns, 536-537  
 colors, foreground and  
 background, 536, 548  
 coordinate plane, 532-535  
 cursors, 551  
 erasing shapes, 544-545  
 filled shapes, 542-544  
 framed shapes, drawing,  
 540-542  
 graphics pen, 535,  
 540-541  
 graphics port drawing  
 state, 551  
 graphics ports, and pixel  
 images, 547-548  
 highlighting, 551  
 icons, 551  
 inverting shapes, 544-545  
 lines, drawing, 540  
 Main QuickDraw  
*constants*, 553  
*data types*, 554  
*functions*, 555-558  
 painted shapes, 542-544  
 pictures, drawing, 545  
 pixel images, copying,  
 547-548  
 pixel patterns, 536  
 pixels, scrolling, 549  
 points (fonts), 532-533  
 polygons, 550

polygons and regions  
*framed*, 542  
*painted and filled*,  
 543-544

QuickDraw demonstration  
 program  
*code listing*, 559-589  
*comments*, 589-599

rectangles, 533-534  
 rectangles and regions,  
 549-550  
 regions, 534-535  
 scaling shapes and regions,  
 550  
 text, drawing, 545-547  
 transfer modes, 537-539

**DrawItemString**, 136

**DrawPicture function**, 24

**drivers, printer**, 797

**dynamic windows**,  
 defined, 184

**dynamically-linked  
 libraries**, 4

## E

**edit menu commands**,  
 1095-1096

**edit menus**, 85-86,  
 1452-1453

**edit text**

control data tag constants,  
 681  
 control part codes, 681  
 control values, 680  
 dialogs, 362  
 field descriptions, 682  
 idle processing, 711  
 programmatic creation,  
 682  
 selection structure, 682

- small version, 710
  - Unicode, 708
  - Unicode text standard control, 254
  - variants and control definition IDs, 680
- Edit text standard control, 253**
- edit text validation function, defining, 713-714**
- editTextValidator, 786-787**
- embedder controls, 260**
- embedding controls**
  - advanced discussion, 662-663
  - advantages of, 264
  - defined, 254
  - group boxes, 685-687
  - latency, 264
  - placards, 699-700
  - radio groups, 703-704
  - root control, 263
  - tab, 676-679
  - user panes, 705-706
  - window headers, 698-699
- embedding hierarchy, 263, 662**
- empty handle, 23**
- empty rectangle, 534**
- emulator (68LC040), 213**
- enhanced sound, 1369**
- Enter Handler, 1360**
- Enter Window, 1360**
- environmental selectors, 1411**
- erasing shapes, 544-545**
- errors**
  - Mac OS 8/9 Memory Manager, 15
  - printing, 808
  - Resource Manager, 25-26
- event categories, 43**
- event filter functions, 901**
- event handling, basics, 892-893**
- Event Manager command-period function, 1415**
- event managers**
  - described, 42
  - See also* Main Event Manager
- event parameters**
  - and command events, 897
  - getting, 896-897
  - setting, 898
- event queue, operating system, 52**
- event record, 898**
- event reference, 893, 898**
- event structure, 46-49**
  - core of Classic event model, 42
  - diagrammatic example, 49
- event time, getting, 900**
- eventFilter**
  - CarbonPrinting demonstration program, 846
  - Controls3 demonstration program, 792-793
  - DialogsAndAlerts demonstration program, 425
  - Lists demonstration program, 1306
  - Windows1 demonstration program, 210
- eventLoop**
  - DialogsAndAlerts demonstration program, 416
  - GworldPicCursIcn demonstration program, 651
  - LowEvents demonstration program, 74
- MLTETextEditor demonstration program, 1501
- Windows1 demonstration program, 204
- events**
  - activate, 1147
  - activate in a list, 1251
  - Apple, 954
  - class, 893-894
  - class (Apple events), 458
  - command, 897
  - controls events, 370-371
  - explicitly propagating, 899
  - filter functions, 370, 374-376
  - functions relevant to MLTE, 1450-1451
  - handlers, standard, 894
  - high-level, 43, 456
  - ID (Apple events), 458-459
  - key-down, 1148
  - key-down in a list, 1250
  - keyboard, 55-56
  - low-level, 43
  - Mac OS X update events, 57-58
  - menu, 954
  - modal alerts events, 371-372
  - modal dialogs events, 372-374
  - ModalDialog, 373-374
  - modeless dialogs events, 377
  - mouse, 53-55
  - mouse-down, 1147-1148
  - mouse-down in a list, 1250
  - mouse-moved events, 43, 60-61
  - null events, 43, 59
  - Operating System, 43
  - OS events and, 44-45



priorities, 45  
 reference, 893  
 responding to, in lists,  
   1250-1251  
 resume events, 43  
 Scripting and Apple  
   Events, 4  
 sending, 899  
 suspend and resume,  
   59-60, 1101  
 timers, 893  
 type, 893-894  
 update events, 1147  
   *defined*, 43  
   *in a list*, 1250  
   *Mac OS 8/9*, 57-58  
*See also* Apple events

**extend algorithms, 1242**  
**extensions fragments, 4**

## F

**families, icon, 614,**  
**616-618**  
**family ID, fonts, 545-546**  
**field descriptions, 46-49**  
   button content info struc-  
   ture, 670-671  
   edit text, 682  
   for graphic devices,  
   510-511  
   ListRec structure,  
   1245-1247  
   NavDialogCreationOptions,  
   967-970  
   NavReplyRecord structure  
   and, 977-978  
   notifications requests, 1399  
   picture structure, 605  
   pixel maps, 502-504  
   TextEdit structure,  
   1143-1145

**file creator, 431**  
**file menus, 85, 805-806,**  
**1451-1452**  
**file reference ('FREF')**  
**resources, 429, 436-437**  
**file reference number,**  
**1052**  
**file synchronization func-**  
**tions, 851-852**  
**file system specification**  
**structure (FSSpec), 466**  
**file types, 431-432**  
   native (Mac OS 8/9),  
   970-971  
   supported by MLTE,  
   1443  
**files, 948-1048**  
   access, 951-952  
   access mode, 957  
   catalog entries, 961  
   closing, 963  
   control block, 951  
   data buffer, 951  
   disk cache, 952  
   document structures,  
   954-955  
   document windows, creat-  
   ing, 955, 957  
   file forks, 948-949  
   Files demonstration pro-  
   gram  
     *code listing*, 987-1029  
     *comments*, 1029-1048  
   Finder Interface functions,  
   982  
   hierarchical file system,  
   952-954  
     *aliases*, 953  
     *directories (folders)*  
       and *IDs*, 952  
     *files and directories*,  
     *identifying*, 953  
     *Main*, 953

*mounted volumes*, 952  
     *root directory*, 952  
 Main File Manager,  
   980-982  
     *constants*, 980-981  
     *data types*, 981  
     *functions*, 981-982  
 Main Navigation Services  
   *constants*, 983-984  
   *data types*, 984-985  
   *functions*, 985-986  
 mark, 951  
 menu and Apple events,  
   954  
 Navigation Services,  
   964-980  
   *application-defined*  
   *functions*, 979-980  
   *Choose a Folder dialog*,  
   972-974  
   *dialogs and alerts*,  
   964-966  
   *Open dialog*, 955-956,  
   966-972  
   *primary alerts, creat-*  
   *ing*, 974-976  
   *primary alerts, event*  
   *handling*, 979  
   *primary dialogs, event*  
   *handling*, 976-978  
   *Save Location dialog*,  
   *creating*, 972  
 opening files, 955-957  
 'PICT', 606  
 reading file data, 957-958  
 reference number, 951  
 Resource Manger func-  
   tions, 982  
 saving, 958-963  
   *reverting to saved file*,  
   962-963  
   *save as command*,  
   958-959

- save command*, 958
  - using FSRef*, 959-960
  - using FSSpec*, 959-960
  - writing file data*, 960-962
- size
  - clumps*, 951
  - file fragmentation*, 951
  - HFS (Mac OS Standard Format)*, 950
  - HFS Plus (Mac OS Extended Format)*, 950
  - logical and allocation blocks*, 949-950
  - logical end-of-file*, 950-951
  - physical end-of-file*, 950
  - volumes*, 949-950
- synchronization function, 963
- types of, 948, 970-972
- Files demonstration program**
  - code listing, 987-1029
  - comments, 1029-1048
    - askSaveDiscardEventFunction*, 1045
    - ChooseAFolderDialog.c*, 1048
    - doAdjustMenus*, 1032
    - doChooseAFolderDialog*, 1048
    - doCloseCommand*, 1036
    - doCloseDocWindow*, 1038
    - doCopyAResource*, 1046
    - doCopyResources*, 1045-1046
    - doCreateAskSaveChangesDialog*, 1039
    - doDrawContent*, 1032
    - doIdle*, 1032
    - doInstallAEHandlers*, 1032
    - doMenuChoice*, 1032
    - doNewCommand*, 1035
    - doNewDocWindow*, 1037-1038
    - doOpenCommand*, 1035
    - doOpenFile*, 1038-1039
    - doReadPictFile*, 1042
    - doReadTextFile*, 1042
    - doRevertCommand*, 1037
    - doSaveAsCommand*, 1036-1037
    - doSaveCommand*, 1036
    - doSaveUsingFSRef*, 1040-1041
    - doSaveUsingFSSpec*, 1039-1040
    - doSynchroniseFiles*, 1046-1047
    - doTouchWindow*, 1033
    - doWriteFile*, 1041-1042
    - doWritePictData*, 1043
    - doWriteTextData*, 1042-1043
    - Files.c*, 1031-1034
    - Files.h*, 1030-1031
    - getFilePutFileEventFunction*, 1043-1044
    - Global Variables*, 1031, 1034
    - main*, 1031-1032
    - NewOpenCloseSave.c*, 1034-1046
    - openAndPrintDocsEventHandler*, 1033
    - openAppEventHandler*, 1033
    - quitAppEventHandler*, 1033-1034
    - reopenAppEventHandler*, 1033
    - SynchroniseFiles.c*, 1046-1047
    - typedefs*, 1031
    - windowEventHandler*, 1032
- Files.c**, 1031-1034
- Files.h**, 1030-1031
- filled shapes**, 536, 542-544
- Filling, Erasing, and Inverting**, 593
- filter functions, events**, 370, 374-376
- Finder**, 428-454
  - aliases, 451
  - application launching by, 448
  - applications
    - file creator*, 431
    - file types*, 431-432
    - required resources*, 429-430
    - signatures*, 429-430
  - basics, 428
  - 'BNDL' resources, 437-440
  - bundles (Mac OS X), 453
  - and catalog file, 448-450
  - constants, data types, and functions, 453-454
  - desktop database (Mac OS 8/9), 428, 439
  - FindFolder, 450
  - flags, 449-450
  - flavor types and, 1311
  - 'FREF' resources, 436-437
  - 'hfdR' resources (Mac OS 8/9), 442
  - icons, 432-436, 614
    - default*, 432
    - design*, 436

*family, 433*

*resources, creating,*  
*434-435*

*sizes, 434-436*

missing application

resources (Mac OS 8/9),  
442-445

packages (Mac OS 9),  
451-453

‘plst’ resource, 445-447

private databases (Mac OS  
X), 429

stationery pads, 450-451

system software and, 2

‘vers’ resources, 440-442

**Finder icon help (‘hfdi’)**  
**resources, 442**

**Finder Interface functions,**  
**982**

**FindFolder, 450**

**flags fields (in**  
**CodeWarrior), 62-65**

**flags, Finder, 449-450**

**flattened collections, 855**

**flavor flags and types,**  
**1310-1311**

**flavors, scrap, 1095**

**floating point numbers,**  
**1161-1162**

**floating windows, 161,**  
**848-850**

**FlushEvents function, 52**

**focus rectangle, drawing,**  
**1249**

**folder type constants, 450**

**folders**

system-related, 450  
*See also* directories

**Font Manager**  
**(QuickDraw), 1137**

**font menus**

basics, 87

handling in MLTE, 1453

## fonts

attributes, 87

cells, 1239

control meta constants,  
278

control style flag con-  
stants, 277-278

control style structure,  
275-276

controls in a dialog,  
363-366

defined, 1136

families

*defined, 1136*

*IDs, 501, 545-546,*  
*1136*

font runs, 1152

measurements, 1136-1137

monospaced, 1136

proportional, 1136

setting in Quickdraw,  
545-546

settings for control titles,  
275-278

size, 545-546, 1137

**foreground colors, 500,**  
**536**

**foreground processes, 44**

**fractional glyph widths,**  
**808-809**

**fragments (Power PC run-**  
**time), 4-5**

**framed shapes, 540-542**

**Framing and Painting,**  
**592**

**Framing, Painting, Filling,**  
**and Erasing, 593**

**FreeMem function, 15**

**‘FREF’ (file reference**  
**resources), 429, 436-437**

**function pointer, 212**

**functional-area suite, 457**

## functions

accessor in PMPageFormat  
objects, 801-802

accessor in

PMPrintSettings objects,  
803-804

Appearance Manager

*cursors, 624*

*QuickDraw and, 558*

application-defined object

filtering, 979-980

application-defined pre-  
views, 980

AsynchSoundLib,  
1378-1380

callback, 895

Carbon Event Manager,  
main, 904-905

Carbon Print Manager, 796

click loop, 1141

controls (Main), 725-728

CreateNewWindow, 855

creating and storing win-  
dows, 854

current pen state, 535

cursors, 623

delay alternative (Mac OS  
X), 901

drag input, 1315

drawing

*Drag Manager and,*  
*1315*

*framed shapes, 540-541*  
*lines, 540*

edit menu in MLTE,  
1452-1453

erasing and inverting  
shapes, 544-545

events in MLTE,  
1450-1451

events, sending, 899

file menu in MLTE,  
1451-1452



- file synchronization, 963
- and Finder, 454
- Finder Interface (files), 982
- floating windows, 850
- Gestalt, 1410-1411
- icons, 626-627
- initialization, 800
- item evaluation, 800
- list definition, 1239
- Main Appearance Manager, 230-231
- Main Apple Event Manager, 471-472
- Main Carbon Printing Manager, 813-815
- Main Carbon Scrap Manager, 1105
- Main Control Manager, 292-294
- Main Core Foundation Preferences Services, 1058-1059
- Main Dialog Manager, 384-386
- Main Drag Manager, 1316-1318
- Main Event Manager, 67
- Main File Manager, 981-982
- Main functions (dates, times, and numbers), 1166-1167
- Main List Manager, 1260-1262
- Main Memory Manager, 26-27
- Main Menu Manager, 117-120
- Main Navigation Services, 985-986

- Main Notification Manager, 1415
- Main QuickDraw, 555-558
- Main Resource Manager, 27-28, 1057-1058
- Main Window Manager, 188-190
- Multilingual Text Engine, main, 1458-1460
- multiple video in QuickDraw, 1415
- offscreen graphics worlds, 619
- painting and filling shapes, 542-543
- pictures, 621-622
- printing loop, 806-807
- promise keeper, 1102
- QuickDraw preliminaries, 514-515
- rectangles, manipulating, 549
- regions, manipulating, 550
- Resource Manager (files), 982
- scrolling pixels (windows), 862
- send data, 1315
- shape filling, 536
- sound, 1377
- Text Utilities, 1262
- TextEdit, 1103
- update region, manipulating, 861
- window information, accessing, 858
- Window Manager, 906
- window proxy icons, 852
- windows, main, 865-867

## G

**GDevice structures, 509-511**

### **Gestalt**

- examples for using, 1412-1413
- function, 1410-1411
- responses, 1412
- selectors, 1411

**Gestalt Manager function, 1418**

**Get and Display Pixel Map's Boundary Rectangle, 529**

**Get and Display RGB Components, 529**

**Get Device List, 528**

**Get Device's Boundary Rectangle, 528-529**

**Get Handle To Color Table, 529**

**Get Handle to Pixel Map, 528**

**Get Main Device, 528**

**GetClcon, 659**

**GetColor function, 1404-1405**

**getFilePutFileEvent Function, 1043-1044**

**GetIcon Suite, 659**

**GetNewCWindow function, 22**

**GetPicture function, 24**

**GetResource function, 22**

**global coordinates system, 169, 532-533**

**global layout settings (MLTE), 1442-1443, 1446-1448**

**Global Variables**

- Appearance demonstration program, 242-243
- AppleEvents demonstration program, 489
- CarbonPrinting demonstration program, 838
- CarbonScrap demonstration program, 1126
- Controls1 demonstration program, 315
- DateTimeNumbers demonstration program, 1232
- DialogsAndAlerts demonstration program, 416
- Drag demonstration program, 1357
- Files demonstration program, 1031, 1034
- GworldPicCursIcn demonstration program, 651
- Lists demonstration program, 1293
- LowEvents demonstration program, 73
- Menus1 demonstration program, 131-132
- Miscellany demonstration program, 1435
- MonoTextEdit demonstration program, 1205
- MoreResources demonstration program, 1083
- QuickDraw demonstration program, 589
- Windows1 demonstration program, 203-204
- Windows2 demonstration program, 884

**Global Variables (Sheets.c), 426****glyphs**

- basics, 1135
- origin, 1137
- widths, fractional and integer, 808-809

**graphic alignment constants, 668****graphics devices, 509-511, 1405**

- field descriptions for, 510-511
- pixel depth, setting, 511

**graphics pen, 535, 540-541****graphics ports**

- and bit patterns, 505-506
- copying from offscreen, 548
- drawing state
  - in Appearance Manager*, 228
  - saving and restoring*, 551
- fundamentals, 168-169, 499-505
- offscreen graphics worlds, 603
- pixels
  - images*, 547-548
  - patterns*, 505
- and QuickDraw, 165
- visible region of, 178-179
- and windows, 156

**Graphics services, 3****gray area (Mac OS 8/9), 258****gray region, 167****grayscale screens, colors on, 509****group boxes**

- control data tag constants, 687
- control part codes, 687

- control values, 686
- programmatic creation, 687
- variants and control definition IDs, 685

**GroupArrowsProgress.c, 787-790****grow image, defined, 182****GworldPicCursIcn demonstration program**

- code listing, 627-650
- comments, 650-659
  - Copy to Window*, 653
  - Define Picture*
    - Rectangle*, 654-655
  - Defines*, 650-651
  - Display Information from Pictinfo*, 655
  - doAboutDialog*, 659
  - doAnimatedCursor1*, 656-657
  - doAnimatedCursor2*, 657
  - doAnimatedCursorOSX*, 659
  - doChangeCursor*, 656
  - doCursor*, 655
  - doEvents*, 651-652
  - doGetAnimCursor*, 657-658
  - doIcon*, 659
  - doIdle*, 651
  - doIncrementAnimCursor*, 658
  - doMenuChoice*, 652
  - doOffScreenGWorld1*, 652
  - doOffScreenGWorld2*, 653-654
  - doPicture*, 654
  - doReleaseAnimCursor*, 658

*Draw in Offscreen Graphics Port*, 653  
*Draw in Window*, 652  
*Draw Picture*, 655  
*eventLoop*, 651  
*GetClcon*, 659  
*GetIcon Suite*, 659  
*Global Variables*, 651  
*Main*, 651  
*PlotClcon*, 659  
*PlotIcon Suite*, 659  
*PlotIconID With Transforms*, 659  
*Record Picture*, 655  
*Release Memory Occupied by Picture*, 655  
*Restore Saved Clipping Region*, 655  
*Set Clipping Region*, 654-655  
*Set Up OpenCPicParams Structure*, 655  
*Stop Recording*, 655  
*typedefs*, 651

## H

**handlers, drag receive and tracking**, 1309, 1311-1312  
**Hardware Interfaces**, 3  
**heap management (Mac OS 8/9)**, 8-12  
   fragmentation, avoiding, 12  
   relocatable blocks, 9-12  
**heaps**, 5-6

### help balloons (Mac OS 8/9)

  ‘hmmu’ resources, 105-107  
   ‘hrct’ and ‘hwin’ resources, 184  
   Resorcerer, creating with, 184-186  
   text for, 107

### Help Dialog, 1205

#### Help menus

  Mac OS 8/9, 86-87  
   Mac OS X, 87

#### help messages, 107

#### help resources, 430

#### Help tags

  constants, 1409  
   creating, 1408-1409  
   data types, 1408  
   enabling and disabling, 1410  
   fundamentals, 1407  
   Main Help Package, 1416-1418  
   for menus, 1410  
   Miscellany demonstration program  
     *code listing*, 1418-1434  
     *comments*, 1434-1439  
   setting display, 1410  
   website for guidelines, 1408  
   for windows, 1410

### HelpDialog.c, 1214-1220

#### helper functions

  bevel buttons, 672  
   disclosure triangles, 695  
   image wells, 675  
   tabs, 678

### HelpTag.c, 1439

### helpWindowEvent Handler, 1215

### ‘hfdr’ (finder icon help) resources (Mac OS 8/9), 442

### HFS (Mac OS Standard Format), 950

### HFS Plus API, 950

### HFS Plus (Mac OS Extended Format), 950

### HGetState (Mac OS 8/9), 13-14

### hiding and showing windows, 184

### hierarchical file system

  aliases, 953  
   directories (folders) and IDs, 952  
   identifying files and directories, 953  
   mounted volumes, 952  
   parent directories and IDs, 953  
   root directory, 952

### hierarchical menus, 88

### high-level events, 456

### highlighting

  basics, 1139  
   cells, 1239  
   messageclose, 1258  
   text and objects, 551

### hit-testing (controls), 264

### HLS and HSV color models, 1403

### horizontal zoom boxes (Mac OS 8/9), 182

### hot rectangles, 184

### hot spot, cursor, 608

### ‘hrct’ and ‘hwin’ resources, 184

### HSetState (Mac OS 8/9), 13-14

### HSV mode, 1404

### hText field, 1146

**huge icons, 434**  
**Human Interface Toolbox,**  
**3**

## I - K

**'icns' resources, 434**  
**icon alignment parameters, 272**  
**'ICON' (icon), 614**  
**Icon standard control, 253**  
**Iconographer, 435**  
**icons**  
 alerts and dialogs, 615-616  
 alignment and transform,  
 617-618  
 color ('cicn'), 614  
 control data tag constants,  
 698  
 control part codes, 698  
 control values, 697  
 default, 432  
 design, 436  
 drawing, 551, 616-618  
 families, 433, 614,  
 616-618  
 and Finder, 432-436, 614  
 GworldPicCursIcn demon-  
 stration program  
   *code listing, 627-650*  
   *comments, 650-659*  
 'ICON', 614  
 Main constants, data types,  
 and functions, 624-627  
 manipulating, 619  
 menus, 615-616  
 programmatic creation,  
 698  
 resources, 429, 434-435  
 sizes, 434, 436  
 small ('SICN'), 615

stretching and shrinking,  
 617  
 suites, 617-618  
 Utilities, 619  
 variants and control defini-  
 tion IDs, 696-697  
 windows, 615-616

**idle processing, 59, 711**  
**IDs**

Apple events, 458-459  
 command, 897  
 font family, 1136  
 resource and local,  
 439-440

**If Direct Device, Get and  
 Display RGB  
 Components, 529**

**image flags, drag, 1314**

**image optimization,  
 1406-1407**

**Image well standard con-  
 trol, 252**

**image wells**

content type constants,  
 674-675  
 control data tag constants,  
 675  
 control part codes, 675  
 control values, 674  
 helper functions, 675  
 programmatic creation,  
 675-676  
 variants and control defini-  
 tion IDs, 674

**imaging, and QuickDraw,  
 496**

**import libraries frag-  
 ments, 4**

**In Window, 1360-1361**

**inactive windows**

active windows and,  
 157-158  
 mouse-down events in,  
 177

**indeterminate progress  
 bar, 690**

**indexed colors and  
 devices, 497, 507**

**information property  
 lists, 429, 445-447**

**informational selectors  
 (Gestalt), 1411**

**initialization**

function, 800, 810  
 message, 1258

**initializationFunction,  
 844-845**

**initializing and terminat-  
 ing MLTE, 1444**

**input, sound, 1368**

**insertion point**

caret, 371  
 defined, 1138  
 setting, 1150

**integer glyph widths,  
 808-809**

**integers, 1158-1159**

**international resources,  
 1154**

**InterProcess Messaging  
 Protocol (AEIMP), 456**

**inverting shapes, 544-545**

**ISA field, 214**

**isApplicableWindow, 1503**

**isOffsetAtLineStart, 1362**

**isWhiteSpace, 1365**

**isWhiteSpaceAtOffset,  
 1365**

**item evaluation function,  
 800, 810, 845-846**

**item flavors, drag,  
 1309-1311**

**item reference numbers,  
 1309-1310**

**key codes, raw and vir-  
 tual, 1139**

**key-down events, 1148, 1250**

**key filter function, defining, 711-713**

**key-map ('KMAP') resource, 1139**

**keyboard events**

character code and virtual key code, 55

Command-period key combination, 56

events not returned to application, 56

and key-down events, 177

keyboard equivalents, 55

**keyboard layout ('KCHR') resource, 1139**

**keyboards**

equivalents, 83-84

focus (dialogs), 360

input and controls, 371

to select cells, 1241-1243

text and, 1138-1139

**keyword-specified descriptors, 461-462**

**'kind' resource, 971**

**kind strings, 970-971**

**kNavCBTerminate message received, 978**

**kNavCBUserAction message received, 977-978**

## L

**latency in controls, 265, 662**

**layering windows, 158**

**LClick, 1240**

**'Ids' resource, 1256-1257**

**leading, 1137**

**Leave Window, 1361**

**left side bearing, 1137**

**lines, 540**

**Lines Drawn with, 590-591**

**linked ring, 1252-1253**

**list box control**

control data tag constants, 1255

control part codes, 1256

control values, 1255

defined, 1238

list box description

resource, 1256-1257

programmatic creation,

1257

variant and control definition ID, 1255

**list box frame, drawing, 1249**

**List box standard control, 253**

**list definition function, 1239**

**List Manager, 1238, 1257-1258**

**list, window, 168**

**listDefFunction, 1304**

**listings. See code listings**

**ListRec structure**

accessor functions, 1245-1247

field descriptions, 1245-1247

**lists, 1238-1306**

appearance of, 1238-1240

cells

font, 1239

highlighting, 1239

keyboard to select,

1241-1243

mouse to select,

1240-1241

creating and managing, 1238

custom list definition functions, 1257-1258

features of, 1238-1240

cells, 1239

scroll bars, 1240

introduction to, 1238

list box control, 1238,

1254-1257

control data tag constants, 1255

control part codes, 1256

control values, 1255

list box description

resource, 1256-1257

programmatic creation, 1257

variant and control definition ID, 1255

List Manager, 1238

Lists demonstration program

code listing, 1262-1290

comments, 1290-1306

Main List Manager,

1259-1261

managing lists, 1243-1254

adding rows and

columns, 1249

automatic drawing

mode, 1250

cell data type, 1244

cell-selection algo-

rithm, 1253-1254

changing current list,

1252-1253

creating, 1248-1249

data, 1251-1252

disposing of, 1249

list selections, setting,

1251

*list structure,*  
1243-1244  
*ListRec structure,*  
1244-1247  
*responding to events,*  
1250-1251  
*scrolling lists,* 1251  
*searching lists,* 1252  
*structure,* 1243-1244

## **Lists demonstration program**

*code listing,* 1262-1290  
*comments,* 1290-1306  
*Defines,* 1291  
*DialogList.c,*  
1305-1306  
*doActivateDeactivate,*  
1294  
*doAddRowsAndDataToI*  
*conList,* 1297-1298  
*doAddRowsAndDataTo*  
*TextList,* 1296  
*doAddTextItemAlphabet*  
*ically,* 1296-1297  
*doArrowKeyExtendSele*  
*ction,* 1299  
*doArrowKeyMoveSelect*  
*ion,* 1298-1299  
*doControlHit,* 1295  
*doCreateIconList,* 1297  
*doCreateTextList,*  
1295-1296  
*doDrawContent,* 1294  
*doDrawFrameAndFocus,*  
1303-1304  
*doDrawSelections,*  
1304  
*doExtractSelections,*  
1304  
*doFindFirstSelectedCell,*  
1301

*doFindLastSelectedCell,*  
1301  
*doFindNewCellLoc,*  
1302  
*doHandleArrowKey,*  
1298  
*doInContent,* 1295  
*doKeyDown,*  
1293-1294  
*doLDEFDraw,* 1305  
*doLDEFHighlight,*  
1305  
*doListsDialog,*  
1305-1306  
*doMakeCellVisible,*  
1302-1303  
*doOpenListsWindow,*  
1293  
*doResetTypeSelection,*  
1303  
*doRestoreBackground,*  
1292  
*doRotateCurrentList,*  
1303  
*doSaveBackground,*  
1292  
*doSearchPartialMatch,*  
1300-1301  
*doSelectOneCell,* 1302  
*doSetBackgroundWhite,*  
1292  
*doTypeSelectSearch,*  
1299-1300  
*eventFilter,* 1306  
*Global Variables,* 1293  
*listDefFunction,* 1304  
*Lists.c,* 1292  
*Lists.h,* 1291-1292  
*Main,* 1292  
*typedefs,* 1292  
*windowEventHandler,*  
1292  
*WindowList.c,* 1292

**Lists.c,** 1292

**Lists.h,** 1291-1292

## **little arrows**

*control part codes,* 693  
*control values,* 693  
*programmatic creation,*  
693  
*variants and control defini*  
*tion IDs,* 692

## **Little arrows standard control,** 251

**live feedback,** 258-259

**live scrolling,** 258-259

**live window resizing,** 863

**LoadResource function,**  
25

## **local coordinates**

*system,* 532  
*window,* 169

**logical blocks,** 949-950

**long date format**  
**resource,** 1154

**low-level events,** 44-45

## **LowEvents demonstration program**

*code listing,* 67-72  
*comments,* 72-77  
*Defines function,* 73  
*doAdjustCursor,* 76-77  
*doEvents,* 74-75  
*doMouseDown,* 75  
*doNewWindow,* 73  
*doOSEvent,* 76  
*doPreliminaries,* 73  
*doUpdate,* 76  
*drawEventString,* 76  
*eventLoop,* 74  
*Global Variables,* 73  
*Main,* 73  
*QuickDraw global and*  
*accessor functions,* 77



## M

### Mac OS 8/9

- animated cursors
  - constants in*, 612
  - creating*, 613
  - custom 'acur' and 'CURS' resources*, 612-613
  - system 'acur' and 'CURS' resources*, 612
- Appearance Manager, 222
- Apple menus, 114-115
- cooperative multitasking, 51
- pull-down menus
  - Application menus*, 86
  - Help menus*, 86-87
- size fields, 65
- system-managed menus, 86
- system software and CarbonLib, 1413
- update region, 57
- updating the window, 57
- window regions, 165
- See also* memory management (Mac OS 8/9)

### Mac OS X

- About command, 115
- animated cursors, 613
- Application and Size menus, 115-116
- Help menus, 87
- memory management, 15-16
  - master pointer allocation*, 16
  - memory allocation*, 15
  - stack size*, 16
- preemptive multitasking, 51

- Preferences command, 115
- Quit command, 115
- update events, 57-58
- virtual memory, 16
- window regions, 166

### MACE (Macintosh Audio Compression and Expansion), 1370

#### Main

- CarbonEvents1 demonstration program, 910
- DateTimeNumbers demonstration program, 1232-1233
- Drag demonstration program, 1357
- Files demonstration program, 1031-1032
- Lists demonstration program, 1292
- Miscellany demonstration program, 1435-1436
- MLTETextEditor demonstration program, 1501
- MonoTextEdit demonstration program, 1205
- SoundAndSpeech demonstration program, 1391

### Main Appearance Manager

- constants, 229-230
- data types, 230
- functions, 230-231

### Main Apple Event Manager

- constants, 470-471
- data types, 471
- functions, 471-472

### Main Carbon Printing Manager

- constants, 812-813
- data types, 813
- functions, 813-815

### Main Carbon Scrap Manager

- constants, 1104
- data types, 1104
- functions, 1105

### Main Carbon Scrap Manager functions, 1099-1100

### Main Control Manager

- constants, 288-290
- data types, 291
- functions, 292-294

### Main Core Foundation Preferences Services, 1058-1059

### Main Dialog Manager

- constants, 382-383
- data types, 383-384
- functions, 384-386

### Main Drag Manager

- constants, 1315-1316
- data types, 1316
- functions, 1316-1318

### main event loop, 42-43

### Main Event Manager, 65-67

- constants, 65-66
- data types, 66
- functions, 67

### Main File Manager

- constants, 980-981
- data types, 981
- functions, 981-982

### Main functions (dates, times, and numbers)

- constants, 1165
- data types, 1165-1166
- functions, 1166-1167

### Main Help Package

- constants, 1416
- data types, 1417
- functions, 1417-1418

**Main List Manager**

- constants, 1259
- data types, 1259-1260
- functions, 1260-1262

**Main Memory Manager**

- data types, 26
- functions, 26-27

**Main Menu Manager**

- constants, 116-117
- data types, 117
- functions, 117-120

**Main Navigation Services**

- constants, 983-984
- data types, 984-985
- functions, 985-986

**Main Notification Manager**

- data types, 1414
- functions, 1415

**Main QuickDraw**

- constants, 553
- data types, 554
- functions, 555-558

**Main Resource Manager**

- constants, 27, 1057
- data types, 1057
- functions, 27-28, 1057-1058

**Main TextEdit**

- constants, 1162
- data types, 1162-1164
- functions, 1164-1165

**Main Window Manager**

- constants, 187-188
- data types, 188
- functions, 188-190

**Mains**

- Appearance demonstration program, 243
- AppleEvents demonstration program, 490
- Carbon Scrap Manager, 1099

CarbonEvents2 demonstration program, 939

CarbonPrinting demonstration program, 838

Controls1 demonstration program, 315-316

Controls2 demonstration program, 334-335

DialogsAndAlerts demonstration program, 416

GworldPicCursIcn demonstration program, 651

LowEvents demonstration program, 73

Menus1 demonstration program, 132

Menus2 demonstration program, 150

MoreResources demonstration program, 1083-1084

PreQuickDraw demonstration program, 527

QuickDraw demonstration program, 589

Windows1 demonstration program, 204

Windows2 demonstration program, 884-885

**major switch, defined, 44****making promises, 1102****manager groups**

- defined, 2
- listed, 2-4

**map, resources, 22, 1054****mark, file, 951****masks, pixel, 548****master pointer tag bytes (Mac OS 8/9), 13-14****match functions, 1252****MaxMem function, 15****'MBAR' resources**

- basics, 81
- compiled structure, 91-92
- Resorcerer, creating with, 100

**MemError function, 15****memory blocks**

- Mac OS 8/9, 6-8
- relocatable & nonrelocatable functions, 26-27

**memory leaks (Mac OS 8/9), 14-15****memory management (Mac OS 8/9), 6-15**

- heaps, 8-12
  - fragmentation, avoiding, 12*
  - relocatable blocks, 9-12*

master pointer tag bytes, 13-14

memory blocks, 6-8

memory leaks, 14-15

Memory Manager errors, 15

**memory management (Mac OS X)**

- master pointer allocation, 16
- memory allocation, 15
- stack size, 16

**Memory Manager errors, 15****memory (Power PC runtime), 5-6****menu adjustment (dialogs), 367-369****menu bar height, 228****menu items (paste), 1097****Menu Manager. See Main Menu Manager****menu objects, 89-90**



**'MENU' resources**

compiled structure, 92-96  
 defined, 81  
 Resorcerer, 100-102

**menus, 80-153**

accessing from alerts and  
 dialogs, 116  
 adjustment, 898  
 applications menus, creat-  
 ing, 91-105  
   *adding to menu list,*  
     105  
   *hierarchical menus,*  
     104-105  
   '*MBAR*' resource struc-  
     ture, 91-92  
   '*MBAR*' resources with  
     Resorcerer, 100  
   *menu bar and pull-*  
     *down menus,* 104  
   '*MENU*' resource struc-  
     ture, 92-96, 100-102  
   '*xmnu*' resource struc-  
     ture, 96-99, 102-103

command IDs, 91, 113  
 data association, 112  
 events, 954  
 fonts in MLTE, 1453  
 Help balloons (Mac OS  
 8/9), 105-107  
 Help tags for, 1410  
 hierarchical, 88  
 icons in, 615-616  
 IDs, 91  
 item numbers, 91  
 items appearance, chang-  
 ing, 108-109  
 Main Menu Manager  
   *constants,* 116-117  
   *data types,* 117  
   *functions,* 117-120

menu bars, hiding and  
 showing, 116  
 menu choices  
   *adjusting menus,*  
     113-114  
   *command IDs,* 113  
   *determining menu ID,*  
     112-113  
   *Mac OS 8/9 Apple*  
     *menus,* 114-115  
   *Mac OS X Application*  
     *and Size menus,*  
       115-116  
   *unhighlighting menu*  
     *titles,* 113  
 menu list, 91  
 Menus1 demonstration  
   program  
     *code listing,* 120-131  
     *comments,* 131-136  
 Menus2 demonstration  
   program  
     *code listing,* 136-149  
     *comments,* 149-153  
 objects, 89-90  
 pop-up, 88  
 pop-up buttons, 274-275  
 pull-down menus, 80-87  
   *Apple (OS 8/9) and*  
     *Application (OS X),*  
       84-85  
   *definition functions,*  
     80-87  
   *Edit,* 85-86  
   *File,* 85  
   *Font,* 87  
   *keyboard equivalents,*  
     83-84  
   *Mac OS 8/9*  
     *Application,* 86  
   *Mac OS 8/9 Help,*  
     86-87

*Mac OS X Help,* 87  
 '*MBAR*' resource, 81  
 menu bar basics, 81  
 menu items and groups,  
 82  
 '*MENU*' resource, 81  
 '*xmnu*' (extended menu)  
 resource, 81

resource and non-resource  
 names, 109, 112  
 strings with metacharac-  
 ters, 109-111  
 strings without metachar-  
 acters, 112  
 types, 80  
 windows, creating, 863

**Menus1 demonstration  
program**

code listing, 120-131  
 comments, 131-136  
   *Defines function,* 131  
   *doAdjustMenus,* 134  
   *doAppleApplication*  
     *Menu,* 135  
   *doEditMenu,* 135  
   *doEvents,* 133-134  
   *doFileMenu,* 135  
   *doFontMenu,* 135-136  
   *doGetMenus,* 132-133  
   *doMenuChoice,*  
     134-135  
   *doMouseDown,* 134  
   *doPreliminaries,* 132  
   *doSizeMenu,* 136  
   *doSpecialMenu,* 136  
   *doSubMenus,* 136  
   *DrawItemString,* 136  
   *Global Variables,*  
     131-132  
   *Main,* 132  
   *quitAppEventHandler,*  
     132

**Menus2 demonstration program**

code listing, 136-149  
 comments, 149-153  
     *doCheckStyleMenuItem*,  
       153  
     *doCommand*, 153  
     *doGetMenus*, 150-152  
     *doMenuChoice*, 152  
     *Main*, 150

**messages (List Manager), 1257-1258****meta font constants, 365-366****metacharacters**

strings with, 109-111  
 strings without, 112

**Metroworks CodeWarrior, 15****minor switch, defined, 44****Miscellany demonstration program**

code listing, 1418-1434  
 comments, 1434-1439  
     *appEventHandler*, 1436  
     *ColorPicker.c*,  
       1438-1439  
     *deviceLoopDraw*, 1439  
     *doDecimalTo*  
       *Hexadecimal*, 1439  
     *doDisplayMessageTo*  
       *User*, 1437-1438  
     *doDrawColorPicker*  
       *Choice*, 1438-1439  
     *doHelpTagControl*,  
       1439  
     *doHelpTagWindow*,  
       1439  
     *doIdle*, 1437  
     *doMenuChoice*, 1436  
     *doPrepareNotification*  
       *Structure*, 1436-1437

*doSetUpNotification*,  
   1436  
*Global Variables*, 1435  
*HelpTag.c*, 1439  
*Main*, 1435-1436  
*Miscellany.c*,  
   1435-1436  
*MultiMonitor.c*, 1439  
*Notification.c*,  
   1436-1438  
*ProgressBar.c*, 1438  
*windowEventHandler*,  
   1436

**Miscellany.c, 1435-1436****missing application resources (Mac OS 8/9), 442-445, 454****Mixed Mode Manager, 213-216****MLTE (Multilingual Text Engine). See Multilingual Text Engine (MLTE)****MLTEMenus.c, 1504-1508****MLTENewOpenCloseSave.c, 1508-1511****MLTETextEditor demonstration program**

code listing, 1461-1500  
 comments, 1500-1511  
     *doActivate*, 1502-1503  
     *doAdjustFileMenu*,  
       1504  
     *doCloseCommand*,  
       1508-1509  
     *doCloseWindow*, 1511  
     *doColorMenuChoice*,  
       1507  
     *doEditMenu*,  
       1504-1505  
     *doEditMenuChoice*,  
       1507

*doEnableDisableMenus*,  
   1504  
*doErrorAlert*, 1504  
*doEvents*, 1502  
*doFileMenuChoice*,  
   1506-1507  
*doFontMenuChoice*,  
   1507  
*doGetSleepTime*,  
   1501-1502  
*doIdle*, 1502  
*doInitializeMLTE*, 1501  
*doInstallAEHandlers*,  
   1501  
*doJustificationMenuChoice*, 1508  
*doMouseDown*, 1502  
*doNewCommand*, 1508  
*doNewDocWindow*,  
   1510-1511  
*doOpenCommand*,  
   1508  
*doOpenFile*, 1511  
*doPrepareColorMenu*,  
   1506  
*doPrepareFontMenu*,  
   1505  
*doPrepareJustification*  
   *Menu*, 1506  
*doPrepareSizeMenu*,  
   1505  
*doPrepareStyleMenu*,  
   1506  
*doQuitCommand*, 1510  
*doRevertCommand*,  
   1509  
*doSaveAsCommand*,  
   1509  
*doSaveCommand*, 1509  
*doSizeMenuChoice*,  
   1507  
*doStyleMenuChoice*,  
   1507

*doSynchronizeFiles*,  
1503  
*doUpdate*, 1503  
*doWriteFile*, 1511  
*eventLoop*, 1501  
*isApplicableWindow*,  
1503  
*Main*, 1501  
*MLTEMenus.c*,  
1504-1508  
*MLTENewOpenClose*  
*Save.c*, 1508-1511  
*MLTETextEditor.c*,  
1501-1504  
*openAndPrintDocs*  
*EventHandler*, 1503

### **MLTETextEditor.c, 1501-1504**

#### **modal alerts**

basics, 340  
and dialogs, 164  
events, 371-372, 374-375,  
376  
and modeless alerts, 61

#### **modal dialogs**

basics, 342-343  
events, 372-375, 376  
and menu adjustment, 369  
and window deactivation,  
368

### **ModalDialog events, 373-374**

#### **mode switches, 213-214**

#### **mode switching, 214-216**

#### **modeless dialogs**

basics, 343  
events and, 370, 377  
menu adjustment, 368-369  
window deactivation, 368  
window usage, 164

#### **modes**

arithmetic source, 539  
Boolean pattern, 537-538  
Boolean source, 538

#### **monitors, multiple**

Classic event model, 1407  
constraining windows,  
1407  
Miscellany demonstration  
program  
code listing, 1418-1434  
comments, 1434-1439  
overview, 1405  
text, 1406-1407  
video devices, 1405-1406

#### **monospaced fonts, 1136**

#### **monostyled TextEdit, 1145-1151**

caret blinking, 1148  
cutting, copying, and past-  
ing, 1148-1149  
events, responding to,  
1147-1148  
insertion point, 1150  
monostyled structure,  
1145-1146  
MonoTextEdit demonstra-  
tion program  
code listing, 1167-1204  
comments, 1204-1220  
selection range, 1150-1151  
text

*alignment*, 1151  
*inserting and deleting*,  
1149

*scrolling*, 1150-1151  
*setting*, 1146

TextEdit documents, sav-  
ing and opening, 1151

*See also* multistyled  
TextEdit; TextEdit

### **MonoTextEdit demonstra- tion program**

code listing, 1167-1204  
comments, 1204-1220  
*actionFunction*,  
1217-1218  
*customClickLoop*,  
1209-1210  
*defines*, 1205, 1214  
*doActivateDeactivate*,  
1208-1209  
*doAdjustCursor*, 1213  
*doAdjustMenus*, 1211  
*doAdjustScrollbar*,  
1212-1213  
*doCloseHelp*, 1220  
*doCloseWindow*, 1213  
*doDrawContent*, 1208  
*doDrawDataPanel*,  
1214  
*doDrawPictures*, 1219  
*doEditMenu*,  
1211-1212  
*doFileMenu*, 1211  
*doGetPictureInfo*,  
1216-1217  
*doGetSelectLength*,  
1212  
*doGetText*, 1216  
*doHelp*, 1214-1215  
*doIdle*, 1206  
*doInContent*, 1208  
*doKeyEvent*, 1206-1207  
*doMenuChoice*, 1211  
*doNewDocWindow*,  
1209  
*doOpenCommand*,  
1213-1214  
*doOpenFile*, 1213-1214  
*doSaveAsFile*,  
1213-1214  
*doScrollTextAndPicts*,  
1219

*doSetBackgroundWhite*, 1220  
*doSetScrollBarValue*, 1210  
*Global Variables*, 1205  
*Help Dialog*, 1205  
*HelpDialog.c*, 1214-1220  
*helpWindowEvent*  
   *Handler*, 1215  
*Main*, 1205  
*MonoTextEdit.c*, 1205-1214  
*scrollActionFunction*, 1207-1208  
*TextEditor*, 1204-1205  
*typedefs*, 1205, 1214  
*userPaneDrawFunction*, 1215-1216  
*windowEventHandler*, 1206

## **MonoTextEdit.c, 1205-1214**

### **MoreResources demonstration program**

code listing, 1059-1082  
 comments, 1082-1091  
   *appEventHandler*, 1084  
   *Defines*, 1083  
   *doCloseWindow*, 1085  
   *doCopyResource*, 1087-1088  
   *doDrawContent*, 1084  
   *doGetPageFormat*, 1090  
   *doGetPreferencesCF*  
     *Prefs*, 1087  
   *doGetPreferences*  
     *Resource*, 1086-1087  
   *doLoadAndSetWindow*  
     *SizeAndPosition*, 1089  
   *doOpenCommand*, 1084

*doOpenWindow*, 1085  
*doPageSetupDialog*, 1086  
*doPreferencesDialog*, 1086  
*doSavePageFormat*, 1090-1091  
*doSavePreferencesCF*  
   *Prefs*, 1088-1089  
*doSavePreferences*  
   *Resource*, 1088  
*doSaveWindowSizeAnd*  
   *Position*, 1089-1090  
*Global Variables*, 1083  
*Main*, 1083-1084  
*navEventFunction*, 1085  
*typedefs*, 1083  
*windowEventHandler*, 1084

## **mouse**

events, 177  
   *content region*, 53  
   *controls*, 279-282  
   *double clicks, detecting*, 55  
   *inactive application*  
     *window*, 54-55  
   *menu bar*, 54  
   *title bar, boxes and*  
     *window proxy icon*, 53-54  
   selecting cells with, 1240-1241  
   tracking, 901

## **mouse-down events**

determining in a control, 280-281  
 inactive windows, 177  
 in lists, 1250  
 TEClick, calling, 1147-1148  
 window proxy icons, 851

## **mouse-moved events**

and cursor shape, 611  
 defined, 43  
 explained, 60-61

## **movement, cursor, 608**

## **Movie, sound, and picture file type, 1443**

## **Multilingual Text Engine (MLTE), 1442-1511**

actions, 1443  
 background, setting, 1448  
 data, setting, 1454-1455  
 edit menu functions, 1452-1453  
 events functions, 1450-1451  
 features of, 1442  
 file menu functions, 1451-1452  
 file types, 1443  
 font menu handling, 1453  
 global layout settings  
   *getting and setting*, 1446-1448  
   *listed*, 1442-1443  
 initializing and terminating, 1444  
 main constants, 1455-1457  
 main data types, 1457-1458  
 main functions, 1458-1460  
 MLTETextEditor demonstration program  
   *code listing*, 1461-1500  
   *comments*, 1500-1511  
 selection behavior, 1443  
 TXNCanUndo and TXNCanRedo, 1453  
 TXNObject, allocating, 1444-1446  
 type attributes, setting, 1448-1450

**MultiMonitor.c, 1439****multiple monitors**

- Classic event model, 1407
- constraining windows, 1407
- image optimization, 1406-1407

**multiple sound channels, 1371****multiple video devices, 1415****multiple windows, 176****multistyled TextEdit**

- text, inserting, 1152
- TextEdit data structures, 1152-1153
- See also* monostyled TextEdit; TextEdit

**multitasking (WaitNext function), 51****N****native file types (Mac OS 8/9), 970-971****NavDialogCreationOptions structure, 967-970****navEventFunction, 1085****Navigation Services, 964-980**

- application-defined functions, 979-980
- Choose a Folder dialog, creating, 972-974
- dialogs and alerts
  - listed, 964*
  - modality, 965*
  - primary dialogs interface elements, 965-966*

- MLTETextEditor demonstration program, 1503

**Open dialog**

- NavDialogCreation Options structure, 967-970*
- opening, 955-956*
- Show pop-up menu, 970-972*

**primary alerts**

- Discard Changes alert, 975*
- event handling, 979*
- Review Changes alert (Mac OS X), 975-976*
- Save Changes alert, 974-975*

**primary dialogs**

- event-handling function, 976-977*
- kNavCBTerminate message, 978*
- kNavCBUserAction message, 977-978*

- Save Location dialog, 972
- stationery pads and, 450-451

**NavReplyRecord structure, 977-978****NavTypeList structure, 971-972****Networking and Communication services, 3****NewFeaturesDialog function, 354-355****NewOpenCloseSave.c, 1034-1046****non-animated cursors**

- 'CURS' and 'crsr' resources, 609-610
- cursor shape, changing, 610-611
- hiding, 612

**non-auto-toggling**

- checkboxes, 257
- radio buttons, 257-258

**noncontiguous cells, selecting, 1241****nonrelocatable memory blocks**

- functions, 26-27
- in Mac OS 8/9, 6-7

**note alert level, 341****Notification Manager, 1398-1399**

- See also* Main Notification Manager

**Notification.c, 1436-1438****notifications**

- elements of, 1398-1399
- field descriptions for requests, 1399
- Main Notification Manager, 1414-1415
- Miscellany demonstration program
  - code listing, 1418-1434*
  - comments, 1434-1439*
- Notification Manager, 1398-1399
- requests
  - creating, 1399-1400*
  - installing and removing, 1401*
- structures, 1399

**null events, 43, 59****null scrap, 1141****number format specification strings, 1159-1161****number parts table, 1154, 1161****numbers**

- DateTimeNumbers demonstration program
  - code listing, 1220-1232*
  - comments, 1232-1235*

- floating point numbers, 1161-1162
- integers, 1158-1159
- international resources, 1154
- Main constants, data types, and functions, 1165-1167
- number format specification strings, 1159-1161
- numeric strings, 1161-1162
- Text Utilities, 1154, 1158
- numeric format resource, 1154**
- numeric strings, 1161-1162**
- numericFilter, 786**

## O

### objects

- collection, 854-855
- region, 534-535
- window, 169-171

### offscreen graphics ports, 548

### offscreen graphics worlds

- creating, 602
- displaying complex images, 548
- drawing preparation, 603-604
- graphics ports, setting, 603
- GworldPicCursIcn demonstration program
  - code listing, 627-650*
  - comments, 650-659*
- Main constants, data types, and functions, 619
- offscreen image copying, 604
- updating and disposing of, 604

### offscreen image copying, 604

### opcodes, 606

### Open dialog (Navigation Services), 955-956, 966-972

### Open Documents Apple events, 459-460, 464

### 'open' resource, 971

### openAndPrintDocsEventHandler, 1033

### openAppEventHandler, 1033

### opening

- files, 955-957
- resource forks, 1052-1053
- TextEdit documents, 1151

### operating environment compatibility

- Gestalt examples, 1412-1413
- Gestalt function, 1410-1411
- Gestalt responses, 1412
- Gestalt selectors, 1411

### Operating System event queue, 52

### optional parameters, 459

### optional scrap flavors, 1095

### OS and low-level events, 44-45

### OS services, common, 2

### outline fonts, 1135

### outline highlighting, 1139

### output, sound, 1368

### overflow and rounding, 1160

## P

### package tool, 453

### packages (Mac OS 9), 451-453

### Page Format objects, 811

### page rectangles, 797-798

### Page Setup

- customizing, 809-810
- window-modal dialogs, displaying as, 811

### Page Setup dialogs, 798-800, 805

### painted shapes, 542-544

### Palette Manager, 511

### paper rectangles, 797-798

### parameters, Apple event, 459

### partial resources, 1055

### partitions, memory, 5-6

### Pascal strings, 35-36

### paste

- command, 1096-1098
- example, 1097-1098
- menu item, enabling, 1097

### pattern modes, Boolean, 537-538

### patterns

- and Appearance primitives, 223
- bit, 536-537
- pixel, 536

### pen location, 535

### persistence (Navigation Services), 965

### 'PICT' files, 606

### picture comments, 606

### Picture standard control, 253



**pictures**

- control data tag constants, 696
- control part codes, 696
- control values, 696
- creating, 606-607
- definition of, 605
- drawing, 545
- gathering information about, 608
- GworldPicCursIcn demonstration program
  - code listing, 627-650*
  - comments, 650-659*
- Main constants, data types, and functions, 620-622
- opcodes, 606
- opening and drawing, 607
- 'PICT' files, 606
- programmatic creation, 696
- saving, 607-608
- scrap format and, 606
- structure of, 605
- variants and control definition IDs, 695

**pixels**

- defined, 496
- depth, setting, 511
- images
  - copying, 547-548*
  - maps and, 502*
- maps, 499
  - field descriptions, 502-504*
  - functions, 505*
- masks, 548
- patterns, 536
  - background, 500*
  - and graphics ports, 505*
- scrolling, 284, 549
- values
  - direct devices, 507-508*
  - indexed devices, 507*

**Placard standard control, 252****placards**

- control values, 699
- programmatic creation, 700
- variants and control definition IDs, 699

**Plain Unicode text file type, 1443****Platinum appearance, 225****PlotClcon, 659****Plotlcon Suite, 659****PlotlconID With Transforms, 659****'plst' (property list)****resource**

- AppleEvents demonstration program, 488-489
- information property lists and, 445-447
- Mac OS 8/9, 31

**PMDialog object, 810****PMPageFormat objects**

- accessor functions, 801-802
- default parameters, assigning, 802
- validating, 803

**PMPrintSettings objects**

- accessor functions, 803-804
- default parameters, 804
- validating, 804

**points, drawing, 532-533****points (fonts), 1137****polygons**

- framed, 542
- manipulating, 550

**pop-up arrows**

- control values, 702
- programmatic creation, 703

small version, 710

standard control, 252

variants and control definition IDs, 701-702

**pop-up menu buttons**

- creating, 274-275
- standard control, 250

**pop-up menus**

- displaying choices, 88
- window path, 853-854

**port rectangles**

- defined, 169
- scrolling pixels in, 549

**positioning specification, 348****PostScript printers, 797****PowerPC considerations, 1161-1162****PowerPC run-time environment, 4-6****preemptive multitasking (Mac OS X), 51****preference domains, 1056****preferences, application, 1055-1056****Preferences folder, 450, 454****Preferences Services, 1055-1056****Preferences command (Mac OS X), 115****preferred scrap flavors, 1095****Preparation, 591-593****PreQuickDraw demonstration program**

- code listing, 516-527
- comments, 527-530
  - doCheckMonitor, 529-530*
  - doDisplayInformation, 528*

*doEvents*, 528  
*doRestoreMonitorPixelDepth*, 530  
*doSetMonitorPixelDepth*, 530  
*Get and Display Pixel Map's Boundary Rectangle*, 529  
*Get and Display RGB Components*, 529  
*Get Device List*, 528  
*Get Device's Boundary Rectangle*, 528-529  
*Get Handle To Color Table*, 529  
*Get Handle to Pixel Map*, 528  
*Get Main Device*, 528  
*If Direct Device, Get and Display RGB Components*, 529  
*Main*, 527

## **preview, file, 965**

## **primary alerts**

### creating

*Discard Changes alert*, 975  
*Review Changes alert (Mac OS X)*, 975-976  
*Save Changes alert*, 974-975

event handling, 979

## **primary dialogs**

### event handling

*event-handling function*, 976-977  
*kNavCBTerminate message received*, 978  
*kNavCBUserAction message received*, 977-978

interface elements, 965-966

## **primary group boxes**

defined, 260  
 standard control, 251

## **Print dialogs**

basics, 799  
 customizing, 809-810  
 displaying as window-modal, 811  
 example, 805-806

## **PrintDialogApppend.c, 844-846**

## **printer drivers, 797**

## **printer resource files, 797**

## **printers, 797**

## **printing. See Carbon printing**

## **printing dialog extension (Mac OS X), 809**

## **printing graphics ports, 509**

## **printing loop function, 806-807**

## **Printing.h, 837-838**

## **private databases (Mac OS X), 429**

## **private scrap**

calling in promises, 1102-1103  
 flavors, 1095  
 making promises, 1102  
 old Scrap Manager, additional actions, 1100-1101  
 TextEdit and, 1141

## **problems, with purgeable resources, 23-25**

## **procedure pointers, 212**

## **Process Manager, 1415**

## **procInfo field, 214**

## **production, sound**

channel allocation, 1374  
 playing sound resource, 1374-1375

'snd' resources, 1372-1373  
 sound channels, 1371  
 sound commands, 1371-1373  
 synchronous and asynchronous sounds, 1373-1374

## **programmatic creation**

bevel buttons, 673  
 chasing arrows, 705  
 clock, 690  
 disclosure triangles, 695  
 edit text, 682  
 group boxes, 687  
 icons, 698  
 image wells, 675-676  
 little arrows, 693  
 pictures, 696  
 placards, 700  
 pop-up arrows, 703  
 progress and relevance bars, 692  
 radio groups, 704  
 scrolling text box, 708  
 separator lines, 701  
 sliders, 684-685  
 static text, 701  
 tabs, 676-679, 679  
 user panes, 706  
 window headers, 699

## **progress and relevance bars**

control data tag constants, 691  
 control values, 691  
 idle processing, 711  
 programmatic creation, 692  
 variants and control definition IDs, 691

## **Progress bar standard control, 251**



**progress bars, 1401**

- determinate, 690
- indeterminate, 690
- Miscellany demonstration program
  - code listing, 1418-1434*
  - comments, 1434-1439*

**ProgressBar.c, 1438****promise keeper functions, 1102****promised flavors, 1102****promises, calling in, 1102-1103**

**property list ('plst') resource. See 'plst' (property list) resource**

**property lists, information, 429, 445-447**

**proportional fonts, 1136****proportional scroll boxes (scrollers), 259****proxy icons, window**

- changing state of, 851
- file synchronization functions, 851-852
- functions, 852
- mouse-down events in, 851

**pull-down menus**

- Apple (OS 8/9) and Application (OS X), 84-85
- definition functions, 80-87
- Edit, 85-86
- File, 85
- Font, 87
- keyboard equivalents, 83-84
- Mac OS 8/9
  - Application menus, 86*
  - Help menus, 86-87*
- Mac OS X Help menus, 87
- 'MBAR' resource, 81

- menu bar basics, 81
- menu items and groups, 82
- 'MENU' resource, 81
- 'xmenu' (extended menu) resource, 81

**purgeable resources, 20-21, 23-25, 1055****PurgeMem function, 15****Push button standard control, 248-249****push buttons**

- basics, 256-257
- content, 272
- default, 256-257
- dialog and alert default, 345
- dialogs, default in, 358-359

**Q****Quick Time managers, 3****QuickDraw, 496-530**

- Color Picker Utilities, 511
- constants, 512
- data types, 512-514
- DeviceLoop function, 1406-1407
- Font Manager and, 1137
- functions, 514-515
- global and accessor functions, 77
- global coordinates, 169
- graphics devices and GDevice structures, 509-511
- graphics ports
  - accessor functions, listed, 499-502*
  - basics, 499*
  - bit patterns, 505-506*

- creating, 506*
- drawing into, 156*
- pixel maps, 499, 502-505*
- pixel patterns, 505*
- window objects and, 168-169*

- imaging and, 496
- multiple video function, 1415

## Palette Manager, 511

- PreQuickDraw demonstration program
  - code listing, 516-527*
  - comments, 527-530*

## printers, 797

## RGB colors and pixels, 496, 506-509

## video devices and colors, 496-498

**QuickDraw demonstration program**

- code listing, 559-589*
- comments, 589-599*
- Defines, 589*
- doArithmeticSource Modes, 596*
- doBooleanSourceModes, 595-596*
- doDemonstrationMenu, 590*
- doDrawingState, 599*
- doDrawingStateProof, 599*
- doDrawWithMouse, 597-598*
- doEvents, 589*
- doFillEraseInvert, 592*
- doFrameAndPaint, 591*
- doHighlighting, 597*
- doLines, 590*
- doPolygonAndRegion, 593*

*doRandomNumber*, 599  
*doScrolling*, 594-595  
*doText*, 594  
*Filling, Erasing, and Inverting*, 593  
*Framing and Painting*, 592  
*Framing, Painting, Filling, and Erasing*, 593  
*Global Variables*, 589  
*Lines Drawn with*, 590-591  
*Main*, 589  
*Preparation*, 591-593

### **QuickDraw, drawing with, 532-599**

Appearance Manager  
     *data types*, 558  
     *functions*, 558  
 bit patterns, 536-537  
 colors, foreground and background, 536, 548  
 coordinate plane, 532-535  
 cursors, 551  
 erasing shapes, 544-545  
 filled shapes, 542-544  
 framed shapes, 540-542  
 graphics pen, 535, 540-541  
 graphics ports  
     *drawing state*, 551  
     *and pixel images*, 547-548  
 highlighting, 551  
 icons, 551  
 inverting shapes, 544-545  
 lines, drawing, 540  
 Main QuickDraw  
     *constants*, 553  
     *data types*, 554  
     *functions*, 555-558  
 painted shapes, 542-544  
 pictures, drawing, 545

pixels  
     *images, copying*, 547-548  
     *patterns*, 536  
     *scrolling*, 549  
 points, 532-533  
 polygons, 550  
 polygons and regions  
     *framed*, 542  
     *painted and filled*, 543-544  
 QuickDraw demonstration program  
     *code listing*, 559-589  
     *comments*, 589-599  
 rectangles, 533-534  
 rectangles and regions, 549-550  
 regions, 534-535  
 scaling shapes and regions, 550  
 text, drawing, 545-547  
 transfer modes, 537-539

### **Quit command, 104, 115, 897-898**

#### **quitAppEventHandler**

Files demonstration program, 1033-1034  
 Menu1 demonstration program, 132

## **R**

### **Radio button standard control, 249**

#### **radio buttons**

auto-toggling, 258  
 non-auto-toggling, 257-258

### **Radio Group standard control, 253**

### **radio groups**

control part codes, 704  
 control values, 704  
 programmatic creation, 704  
 variants and control definition IDs, 703

### **raw key code, 1139**

### **ReceiveAndUndoDrag.c, 1362-1366**

### **Record Picture, 655**

### **recording quality, 1375**

### **recording sound (Mac OS 8/9), 1374-1375**

### **rectangles**

drawing, 533-534  
 manipulating, 549-550

### **reference number, file, 951**

### **region objects, 534-535**

#### **regions**

clipping, 500, 607  
 drawing, 534-535  
 manipulating, 549-550  
 windows

*Mac OS 8/9*, 165

*Mac OS X*, 166

### **Release Memory**

#### **Occupied by Picture, 655**

### **ReleaseResource function, 25**

### **releasing resources, 1052**

### **relevance bar, 691**

### **Relevance bar standard control, 254**

### **relocatable memory blocks**

application heaps, inside, 7-8  
 heap management and, 8-12, 26-27

**reopenAppEventHandler,  
1033****requests, notification**

creating, 1399-1400  
installing and removing,  
1401

**required Apple events,  
467-470****required parameters, 459****ResError function, 25****resizing windows,  
182-183****Resorcerer (resource edi-  
tor)**

basics, 19, 91  
creating with  
    '*BNDL*' resources, 438  
    '*CNTL*' resources,  
        270-271  
    '*dfib*' resources, 366  
    '*DITL*' resources,  
        358-359  
    '*DLOG*' and '*dlgx*'  
        resources, 353-354  
    '*FREF*' resources,  
        436-437  
    '*hdlg*' resources, 381  
    *help balloons* (Mac OS  
        8/9), 184-186  
    *help items*, 380  
    *icon resources*, 434-435  
    '*kind*' resources, 971  
    '*lids*' resources,  
        1256-1257  
    '*MBAR*' resources, 100  
    '*MENU*' resources,  
        100-102  
    '*MENU*' resources for  
        submenus, 102  
    '*open*' resources, 971  
    '*plst*' resources, 447  
    signature resources,  
        430

'*vers*' resources, 441  
windows, 171  
'*xmnu*' resources,  
102-103

**resource and non-  
resource names, 109,  
112****resource forks, 948-949,  
1052-1053****Resource Manager**

errors, 25-26  
functions, 982

**resource map, 1054****resources**

application preferences,  
1055-1056  
attributes, purgeable and  
unpurgeable, 20-21  
Core Foundation  
    Preferences Services,  
        1055-1056  
creating, 19-21  
current resource file,  
1051-1052  
data and resource forks,  
16-17  
IDs, 62  
indexing through, 1054  
international, 1154  
key-map ('*KMAP*'), 1139  
keyboard layout  
    (''*KCHR*''), 1139  
    '*kind*', 971  
    '*lids*', 1256-1257  
Main Core Foundation  
    Preferences Services,  
        1058-1059  
Main Resource Manager,  
1057-1058  
MoreResources demon-  
stration program  
    code listing, 1059-1082  
    comments, 1082-1091

partial, 1055  
'*PICT*', 606  
preloaded and non-pre-  
loaded, 22  
purgeable, 1055  
purgeable and unpurgeable  
    attributes, 23-25  
reading and manipulating,  
1054  
releasing and detaching,  
1052  
resource forks, 1052-1053  
resource maps, 22, 1054  
search order, default, 1051  
search path, 1050-1052,  
1051  
'*snd*', 1372-1373  
sound, 1370, 1375  
template and definition, 21  
types & IDs, 18-19  
writing, 1054-1055

**Restore Saved Clipping  
Region, 655****resume events, 43, 611,  
1101****Review Changes alert  
(Mac OS X), 975-976****Rez (resource compiler),  
19, 91****RGB colors**

model, 1402  
pixel values, 506-509  
pixels and, 496

**RGB mode, 1403-1404****root control, 263****round button, 709-710****Round button standard  
control, 254****routine descriptors**

Control Action function,  
215  
creating and disposing of,  
215, 217

effects of, 215  
functions requiring, 216

**routine structures, 214**

**rows and columns, 1249**

**RunApplicationEventLoop,  
893**

**Runtime services, 4**

## S

**sample rate and size,  
1369-1370**

**sampled sound,  
1368-1370**

**Save Changes alert,  
974-975**

**Save Location dialog, 972**

**saving files**

FSRef for, 959-960  
FSSpec for, 959-960  
reverting to saved file,  
962-963  
save as command, 958-959  
save command, 958  
TextEdit documents, 1151  
writing file data, 960-962

**scaling shapes and  
regions, 550**

**scrap**

clipboard windows, 1098  
cut and copy commands,  
1096  
dialogs and, 1103  
edit menu commands,  
1095-1096  
flavor flags  
*constants, 1099-1100*  
*and types, 1094*  
flavors, 1095  
format, 606  
location of, 1094

Main Carbon Scrap  
Manager functions,  
1099-1100  
paste command,  
1096-1098  
paste example, 1097-1098  
private, null, and style,  
1141  
reference, 1094-1095  
scrap flavors, 1095  
scrap reference, 1094-1095  
transferring to disk in Mac  
OS 8/9, 1098-1099

**Scrap Manager, 1094,  
1100-1101**

*See also* Carbon Scrap  
Manager

**ScrapFlavorInfo data  
type, 1100**

**screen position to text  
offset, 1138**

**Scripting and Apple  
Events, 4**

**scroll arrows, 249, 258**

**Scroll bar standard con-  
trol, 249**

**scroll bars**

activating and deactivating,  
261  
creating, 258-259, 272-274  
described, 157  
horizontal and vertical,  
256  
in lists, 1240  
moving and resizing, 283  
scrolling example,  
285-286  
scrolling operations basics,  
283-285  
scrolling TextEdit docu-  
ments, 287  
and window controls, 167

**scroll boxes**

basics, 258-259  
Mac OS 8/9, 249  
proportional, 222

**scrollActionFunction,  
1207-1208**

**scrolling**

automatic, 1141, 1150  
lists, 1251  
text, 1150-1151  
windows, functions and  
constants, 862

**scrolling operations**

basics, 283-285  
example, 285-286  
moving and resizing bars,  
283  
TextEdit documents, 287

**Scrolling text box stan-  
dard control, 253**

**scrolling text boxes,  
706-708**

control data tag constants,  
707  
control values, 707  
idle processing, 711  
programmatic creation,  
708  
variants and control defini-  
tion IDs, 706-707

**search order**

current resource file, 1052  
default, 1051

**search path, resources,  
1050-1052**

**searching lists, 1252**

**Secondary group box  
standard control, 252**

**selection behavior (MLTE),  
1443**

**selection range,  
1138-1139, 1150**

**send data function (Drag Manager), 1315**

**Separator line standard control, 251**

**separator lines, 701**

**sequence and scope**

session functions, 807

universal functions, 808

**server applications, 456**

**session functions (printing), 807**

**sessions, printing, 796**

**Set Clipping Region, 654-655**

**Set Up OpenCPicParams Structure, 655**

**setting the cursor, 611**

**settings**

Page Setup dialog, 798-799

Print dialog, 799-800

**shapes**

cursor and mouse-moved events, 611

cursor and resume events, 611

cursors, 609, 898-899

erasing, 544-545

filling, 536, 542-544

framed, 540-542

inverting, 544-545

painted, 542-544

scaling, 550

**shared libraries, defined, 4**

**sheet alerts (Mac OS X), 340**

*See also* window-modal alerts (Mac OS X)

**sheet dialogs (Mac OS X), 343**

*See also* window-modal dialogs (Mac OS X)

**sheetEventHandler, 944**

**Sheets.c, 426**

**shift-clicking (cell selection), 1241**

**shift key (cell selection), 1240**

**Show pop-up menu, 970-972**

**Show Preferences event, 457**

**showPreferenceEventHandler, 492**

**'SICN' (small icon), 615**

**signature resources, 429**

**size box, 157**

**size fields (Mac OS 8/9), 65**

**size, file**

clumps, 951

file fragmentation, 951

HFS (Mac OS Standard Format), 950

HFS Plus (Mac OS Extended Format), 950

logical and allocation blocks, 949-950

logical end-of-file, 950-951

physical end-of-file, 950 volumes, 949-950

**Size menus (Mac OS X), 115-116**

**size, of fonts, 1137**

**'SIZE' resources, 62-65, 429**

**sizing windows, 1407**

**sleep parameter (WaitNext function), 51**

**Slider standard control, 250**

**sliderActionFunction1, 793**

**sliderActionFunction2, 793**

**sliders**

bars and indicators, 682

control part codes, 684

control values, 684

programmatic creation, 684-685

small version, 710

variants and control definition IDs, 683-684

**Sliders.c, 790-792**

**SmallControls.c, 794**

**'snd' resources, 1372-1373**

**sound**

AsynchSoundLib Library, 1377-1380

audio hardware, 1368

components, 1370

constants, 1376

data, 1369

data types, 1376-1377

enhanced sound, 1369

functions, 1377

input and output, 1368

production

*channel allocation, 1374*

*playing sound resource, 1374-1375*

*'snd' resources, 1372-1373*

*sound channels, 1371*

*sound commands, 1371-1373*

*synchronous and asynchronous, 1373-1374*

recording (Mac OS 8/9), 1374-1375



- resources, 1370, 1375
- sampled, 1368
- SoundAndSpeech demonstration program
  - code listing, 1381-1391*
  - comments, 1391-1395*
- speech
  - generating from strings, 1376*
  - Speech Manager, 1368, 1375*
  - synchronous and asynchronous, 1376*
- system software, 1368
- Sound Input Manager, 1368, 1375**
- Sound Manager, 1368, 1370**
- SoundAndSpeech demonstration program**
  - code listing, 1381-1391*
  - comments, 1391-1395*
  - Defines, 1391*
  - doIdle, 1392*
  - doInitialiseSoundLib, 1392*
  - doPlayResourceASync, 1394-1395*
  - doPlayResourceSync, 1392-1393*
  - doRecordResource, 1393-1394*
  - doSetUpDialog, 1395*
  - doSpeakStringASync, 1395*
  - doSpeakStringSync, 1394*
  - Main, 1391*
- sounds, transitional window, 854**
- source modes**
  - arithmetic, 539
  - Boolean, 538
- Speech Manager, 1368, 1375**
- square wave data, 1369**
- stack frame, defined, 6**
- StackSpace function, 16**
- standard alert parameter structure, 346-347**
- standard application event handler, 894**
- standard controls, listed, 248-254**
- standard event handlers, 892, 894**
- standard scrap flavors, 1095**
- standard state, defined, 175**
- standard window event handler, 894**
- StandardAlert function**
  - alert default text constants, 347-348
  - alert push button constants, 348
  - positioning specification, 348
  - standard alert parameter structure, 346-347
- StartAndTrack.c, 1358-1362**
- static text**
  - control data tag constants, 700-701
  - control values, 700
  - dialogs, 362
  - programmatic creation, 701
  - variants and control definition IDs, 700
- Static text standard control, 253**
- static windows, defined, 184**
- stationery pads, 450-451**
- stop alert level, 341**
- Stop Recording, 655**
- structures**
  - data cache, 1155-1158
  - dispatch, 1142, 1145
  - document, 954-955
  - file system specification, 953-954
  - list, 1243-1244
  - ListRec, 1244-1247
  - monostyled TextEdit, 1145-1146
  - NavReplyRecord, 977-978
  - notification, 1399
  - primary Text Edit data, 1142-1145
  - style, 1152
  - TextEdit, 1140, 1142-1145
- style runs, 1151-1152**
- style scrap, 1141**
- style structure, 1152**
- styles, text, 1136**
- suites, icons, 617-618**
- suspend and resume events, 43, 59-60, 60, 1101**
- SynchroniseFiles.c, 1046-1047**
- synchronization function, file, 963**
- synchronous and asynchronous**
  - sound, 1373-1374
  - speech, 1376
- SysMemRes demonstration program**
  - code listing, 28-31*
  - comments, 31-39*
  - Defines, 32*
  - doMemory, 33-34*

*doNewWindow*, 33  
*doPreliminaries*, 33  
*doResources*, 34-35  
*includes*, 31-32  
*Main*, 32  
*plst* (property list)  
     *resource*, 31

**system event mask**

**System files resources**, 17

**system highlight color**,  
 551

**system partitions (mem-  
 ory)**, 5

**system reference, file**,  
 953-954

**system software**

and CarbonLib, 1413  
 in Classic Event model,  
 44-45  
 functions, 2-4  
 and sound, 1368

**system specification struc-  
 ture, file**, 953-954

## T

**T-Vector tests**, 1414

**Tab standard control**, 251

**TabEditClock.c**, 783-787

**tabs**

control data tag constants,  
 677  
 control values, 677  
 helper functions, 678  
 programmatic creation,  
 676-679  
 small version, 709  
 tab information resource,  
 678-679  
 tab information structure,  
 678

variants and control defini-  
 tion IDs, 676-677

**target applications**, 459

**TEClick, calling**, 1147

**template resources**, 21

**Temporary Items folder**,  
 450, 454

**TESetText, calling**, 1146

**TEUpdate, calling**, 1147

**text**

alignment and placement  
 constants, 668-669  
 alignment, setting, 1151  
 in Appearance Manager,  
 227  
 caret position and text off-  
 set, 1138  
 characters, sets, and codes,  
 1134-1135  
 color constants, 227  
 converting screen position,  
 1138  
 cutting and copying,  
 1148-1149  
 drawing, 545-547  
 Font Manager and  
     QuickDraw, 1137  
 font measurements,  
 1136-1137  
 fonts and families, 1136  
 glyphs, 1135, 1137  
 input, 1148  
 inserting and deleting,  
 1149  
 inserting multistyled, 1152  
 keyboards and, 1138-1139  
 offset, 1138  
 pasting, 1148-1149  
 screen and printed,  
 808-809  
 scrolling, 1150-1151  
 segments, 1152

selection range, 1138-1139  
 setting, 1146  
 styles, 546, 1136  
 typefaces, 1136

**Text file type**, 1443

**Text International ser-  
 vices**, 4

**text title variant**. *See* pri-  
 mary group boxes

**Text Utilities**, 1154, 1158,  
 1262

**Text Utilities function**,  
 1243

**TextBox.c**, 792

**TextEdit**

automatic scrolling, 1141  
 basics, 1139  
 caret position and move-  
 ment, 1141  
 data structures, primary,  
 1142-1145  
 destination rectangle, 1142  
 documents  
     *saving and opening*,  
     1151  
     *scrolling*, 287  
 editing tasks, 1139-1140  
 functions  
     *Carbon scrap*, 1103  
     *drag and drop*, 1318  
 monostyled and multi-  
 styled text, 1140  
 private, null, and style  
 scraps, 1141  
 static text, displaying,  
 1140  
 structure, 1140, 1142-1145  
 text alignment, 1142  
 using indirectly, 1140  
*See also* monostyled  
     TextEdit; multistyled  
     TextEdit

**TextEdit**, 1204-1205  
**Textension file type**, 1443  
**themes (Appearance Manager)**  
     compliance, 221-222  
     definition, 221  
**thumbnail icons**, 434-436  
**time**. *See* **dates and times**  
**timers, event**, 893, 900  
**title bar**, 157  
**tokens resource**, 1154  
**toolbar windows**, 850  
**track (Mac OS X)**, 258  
**tracking handlers, drag**, 1311-1312  
**transfer modes**  
     arithmetic source modes, 539  
     Boolean pattern modes, 537-538  
     Boolean source modes, 538  
     erasing operations, 544  
     glyphs, 546-547  
     painting operations, 542  
     pen, 501  
**transform parameters, icon**, 617-618  
**translucent drags**, 1313-1314  
**Trash folder**, 450, 454  
**TXNCanUndo and TXNCanRedo**, 1453  
**TXNObject, allocating**, 1444-1446  
**type attributes (MLTE)**, 1448-1450  
**type-dependent update functions (Mac OS X)**, 179

**type selection**, 1242-1243  
**typedefs**  
     CarbonPrinting demonstration program, 838  
     CarbonScrap demonstration program, 1126  
     Controls1 demonstration program, 315  
     Controls3 demonstration program, 779  
     Drag demonstration program, 1356  
     Files demonstration program, 1031  
     GworldPicCursIcn demonstration program, 651  
     Lists demonstration program, 1292  
     MonoTextEdit demonstration program, 1205, 1214  
     MoreResources demonstration program, 1083  
     Windows2 demonstration program, 884  
**typefaces**, 1136

## U

**Unicode**, 37-39  
**universal functions (printing)**, 808  
**universal headers comments**, 1413-1414  
**universal procedure pointers**, 211-217  
     68LC040 emulator, 213  
     and Carbon, 216-217  
     control data tag constants, 716-718  
     introduction to, 212  
     Mixed Mode Manager, 213-216  
**unmounted volumes**, 953  
**unpurgeable resources**, 20-21, 23-25  
**update events**  
     defined, 43  
     in lists, 1250  
     Mac OS 8/9, 57-58, 177-179  
     Mac OS X, 179-180  
     TEUpdate, calling, 1147  
**update region**  
     adding and removing, 861  
     Mac OS 8/9, 57, 179  
**updating**  
     controls, 279  
     windows (Mac OS 8/9), 57  
**UPP (universal procedure pointer)**. *See* **universal procedure pointers**  
**User pane standard control**, 252  
**user panes**  
     basics, 260  
     control data tag constants, 706, 716-717  
     control values, 706  
     functions, defining, 714-718  
     programmatic creation, 706  
     variants and control definition IDs, 705-706  
**user state, defined**, 175  
**userPaneActivateFunction**, 792  
**userPaneDrawFunction**  
     Controls3 demonstration program, 791  
     MonoTextEdit demonstration program, 1215-1216  
**Utilities, Icon**, 619  
**utility windows**, 850



## V

### variants and control definition IDs

- bevel buttons, 664-665
- chasing arrows, 704-705
- clock, 688
- disclosure triangles, 694
- edit text, 680
- group boxes, 685
- icons, 696-697
- image wells, 674
- little arrows, 692
- pictures, 695
- placards, 699
- pop-up arrows, 702
- progress and relevance bars, 691
- radio groups, 703
- scrolling text box, 706-707
- separator lines, 701
- sliders, 683-684
- static text, 700
- tabs, 676-677
- user panes, 705-706
- window headers, 698-699
- variation codes, 162-163, 256**
- 'vers' (version) resources, 430, 440-442**
- vertical zoom boxes (Mac OS 8/9), 182**
- video devices, 1405-1406**
  - and colors, 496-498
  - for graphics, 509
  - multiple, 1415
- view rectangles, 1141**
- virtual key code, 1139**
- virtual memory (Mac OS X), 16**
- visibility**
  - cursor, 609
  - pen, 501

### visible region, 500

### visible region (graphics ports), 178-179

### visual feedback (controls), 262-263

### volume

- control block (VCB), 953
- name, 953
- reference number, 953

### volumes, 949-950

## W

### WaitNextEvent function (Classic)

- Carbon WaitNext, 51
- Classic event model, 42

### wave-table data, 1369

### WDEF (window definition function), 162-163

### website (Help tag guidelines), 1408

### wedges, 543

### 'WIND' resources

- compiled structure, 172-173
- and flattened collections, 855
- positioning specification, 173-174
- Resorcerer, creating with, 174
- scroll bars, adding, 174
- and window visibility, 175
- windows, creating, 174

### Window Manager, 906

- See also* Main Window Manager

### Window Manager function, 1416

### windowEventHandler

- CarbonEvents1 demonstration program, 910-911
- CarbonEvents2 demonstration program, 940-942
- CarbonScrap demonstration program, 1127
- DateTimeNumbers demonstration program, 1233
- Drag demonstration program, 1357
- Files demonstration program, 1032
- Lists demonstration program, 1292
- Miscellany demonstration program, 1436
- MonoTextEdit demonstration program, 1206
- MoreResources demonstration program, 1084

### WindowList.c, 1292

### windows

- active and inactive, 157-158
- animation and sounds, 854
- applications windows, creating
  - drawing window contents, 176*
  - positioning document windows, 175-176*
  - 'WIND' resources, 171-175*
- associating data with, 861
- basics, 156-158
- Bring All To Front, 158
- clipboard, 1098
- close box, 157
- collapse box, 157
- constants, main, 864
- constraining to one screen, 1407

- content region, color and pattern, 861
- controls and control lists, 167-168
- creating and storing
  - collections*, 854-855
  - CreateNewWindow* function, 855
  - flattened collections*, 855
  - functions for*, 854
  - 'wind'* resources, 855
  - window attribute constants*, 857-858
  - window class constants*, 856
- data types, main, 865
- document windows, 156, 955
- draggable area, 157
- events handling
  - activate events*, 180
  - keyboard events*, 177
  - mouse events*, 177
  - update events (Mac OS 8/9)*, 177-179
  - update events (Mac OS X)*, 179-180
- events in, 171
- floating windows
  - functions*, 850
  - manipulating*, 849
- functions, main, 865-867
- graphics ports
  - basics*, 168-169
  - defined*, 156
- help balloons (Mac OS 8/9)
  - 'hrcr'* and *'hwin'* resources, 184
  - Resorcerer*, creating with, 184-186
- Help tags for, 1410
- icons in, 615-616
- information, accessing, 858
- layering, 158
- live window resizing, 863
- Main Window Manager, 187-190
  - constants*, 187-188
  - data types*, 188
  - functions*, 188-190
- manipulating
  - closing*, 183-184
  - dragging*, 180-181
  - hiding and showing*, 184
  - resizing*, 182-183
  - zooming*, 181-182
- menu, 863
- moving, 858
- multiple windows, 176
- path pop-up menus, 853-854
- positioning
  - basics*, 859
  - constants*, 859-861
- proxy icons
  - changing state of*, 851
  - file synchronization functions*, 851-852
  - functions*, 852
  - mouse-down events*, 851
- regions, 164-167
- scrolling functions and constants, 862
- size box, 157
- standard elements, 156-157
- title bar, 157
- toolbar, 850
- types of, 158-164
  - definition IDs and functions*, 162-163
  - dialogs and alerts*, 160
  - documents*, 158-159, 164
  - floating*, 161
  - modal alerts and dialogs*, 164
  - type usage*, 164
- update region and, 861
- updating, 899
- utility, 850
- 'WIND' resources, 171-175
  - adding scroll bars*, 174
  - compiled structure*, 172-173
  - creating window from*, 174
  - positioning specification*, 173-174
  - Resorcerer*, creating with, 174
  - and window visibility*, 175
- window deactivation (dialogs), 367-368
- window definition function (WDEF), 162-163
- window definition IDs, 162-163, 343-344
- window event handler, standard, 894
- Window header standard control, 253
- window headers
  - control values*, 699
  - programmatic creation*, 699
  - variants and control definition IDs*, 698-699
- window list, 168
- window-modal alerts
  - creating and displaying*, 378-379
  - Mac OS X*, 340

window-modal dialogs  
     *creating and displaying*, 379  
     *Mac OS X*, 343  
     *Page Setup and Print dialogs*, 811  
 window objects, 169-170  
 window types (dialogs and alerts), 343-344  
 Windows2 demonstration program  
     *code listing*, 867-883  
     *comments*, 883-890  
 zoom box, 157  
 zooming, dragging and sizing, 1407

### **Windows1 demonstration program**

code listing, 190-202  
 comments, 202-210  
     *Defines*, 203  
     *doActivate*, 207  
     *doActivateWindow*, 207-208  
     *doConcatPStrings*, 210  
     *doErrorAlert*, 210  
     *doEvents*, 204  
     *doFileMenu*, 208  
     *doInvalidateScrollBar Area*, 210

*doMenuChoice*, 208  
     *doMouseDown*, 204-206  
     *doNewWindow*, 208-209  
     *doOSEvent*, 208  
     *doPreliminaries*, 204  
     *doUpdate*, 206  
     *doUpdateWindow*, 207  
     *doWindowsMenu*, 208  
     *eventFilter*, 210  
     *eventLoop*, 204  
     *Global Variables*, 203-204  
     *Main*, 204

### **Windows2 demonstration program**

code listing, 867-883  
 comments, 883-890  
     *Defines*, 884  
     *doActivateDocumentWindow*, 886  
     *doAdjustMenus*, 886  
     *doCloseWindow*, 890  
     *doCreateFloating Windows*, 887  
     *doCreateNewWindow*, 887-888  
     *doCreateWindowFrom Resource*, 889-890

*doErrorAlert*, 890  
     *doMenuChoice*, 886-887  
     *doMouseDown*, 885  
     *doSaveWindow*, 888-889  
     *doUpdate*, 886  
     *doUpdateDocument Window*, 886  
     *Global Variables*, 884  
     *Main*, 884-885  
     *typedefs*, 884

### **writing systems, 37**

### **WYSIWYG font menus, 87**

## **X - Z**

### **'xmnu' (extended menu) resources**

compiled structure, 96-99  
 defined, 81  
 Resorcerer, creating with, 102-103

### **ZoneRanger memory tool, 15**

### **zoom box, 157**

### **zoom state, defined, 176**

### **zooming windows, 181-182, 1407**





# Carbon Programming

This book teaches you how to write programs for the Apple Macintosh computer using the the Carbon Application Programming Interface (API), the C language, and the Metrowerks CodeWarrior development system. The use of the Carbon API ensures that your programs will run native on both Mac OS 9 and Mac OS X, and take advantage of the advanced features of Mac OS X when run on that system. The book also teaches you how to “carbonize” existing non-Carbon programs so that they will run native on Mac OS X.

*Carbon Programming* provides in-depth coverage of many aspects of Macintosh programming, and includes source code listings and explanatory comments for 27 demonstration programs. The companion Web site contains the ready-to-compile project, source code, and resource files for all demonstration programs.

## In *Carbon Programming* you will learn how to

- Create and manage all elements of the Mac OS 9 and Mac OS X graphical user interfaces (menus, windows, dialogs, alerts, sheets, controls, lists, help balloons and tags, icons, cursors, and so on).
- Perform file input/output, and create and manage the associated dialogs and alerts.
- Implement printing, scrap management, drag and drop, sound and speech, notifications, Apple Help, multiple-monitor support, interapplication communication, Finder support, and so on.
- Draw text and graphics, format and display dates, times, and numbers, and create basic text-editing applications.

**K.J. Bricknell** is the author of *Macintosh C: A Hobbyist's Guide to Programming the Mac OS in C*, which was first published on the Internet in early 1996. That work is currently hosted by *MacTech* magazine, the only magazine focused on Macintosh technology and development, distributed in 64 countries, and read by tens of thousands of programmers and solution providers. *Carbon Programming* is a “carbonized” and significantly expanded version of *Macintosh C*, and incorporates much feedback, received over more than five years, from users of that product.

\$49.99 USA

\$74.95 CAN

£36.50 Net UK

Category: Macintosh Programming

Covers: Carbon

User Level: Beginner – Intermediate

**SAMS**

www.sampublishing.com

**InformIT**  
Find IT Solutions at  
www.informit.com

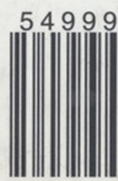
ISBN 0-672-32267-6



7 52063 32267 3



9 780672 322679



5 4 9 9 9